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OF THE

AMERICAN PHILOSOPHICAL SOCIETY

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PART I.

ARTICLE I.—*The History of the Pelycosauria, with a Description of the Genus Dimetrodon, Cope. By G. Baur and E. C. Case.*

Philadelphia:

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TRANSACTIONS

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AMERICAN PHILOSOPHICAL SOCIETY.

ARTICLE I.

THE HISTORY OF THE PELYCOSAURIA, WITH A DESCRIPTION OF THE GENUS DIMETRODON, COPE.*

BY G. BAUR AND E. C. CASE.

Read before the American Philosophical Society, March 3, 1899.

Historical.

The first remains of Permian Reptiles in the United States were described by Prof. Cope[1] in 1875 from near Danville, Vermillion county, in eastern Illinois. It was left undecided whether the strata from which the fossils came belonged to the Triassic or the Permian. The vertebrate remains are unaccompanied by invertebrate fossils, but the invertebrate remains of the region are all Carboniferous forms. Mr. Gurley, of Danville, the discoverer of the fossils, considers that the vertebrate remains came from deposits in the bed of an ancient river of the Permian time which cut through the underlying Carboniferous rocks. This, if true, explains the puzzling feature of these typically Permian forms occurring on the same level with the Carboniferous invertebrates.

The genus and species *Clepsydrops collettii* Cope was established, based on cervicals, including the axis, dorsal and caudal vertebræ; besides proximal ends of ribs, an

*Prefatory Note.—The unfortunate death of Dr. Baur left the manuscript of this article in the hands of the junior author in an unfinished condition, and he has attempted to complete it with as little change from the original portion written by Dr. Baur as possible. The historical part, with the exception of the Russian and the Bohemian forms, and a portion of the African forms, was the work of Dr. Baur. The description of the skeleton was the work of the junior author, with the advice of Dr. Baur.

astragalus, considered first as a coracoid bone, and some phalanges, which were provisionally referred to the same genus. The vertebræ are deeply biconcave, and notochordal. There are no processes on the centra, but a small capitular, articular face is present on the anterior articular edge of two of the dorsals. The dorsal vertebræ have the sides somewhat contracted; in one specimen the inferior face rounded, in another it is longitudinally acute. The diapophysis does not project far beyond the base of the neural arch, and is compressed. The caudals are elongate. Then follow remarks about the ribs, astragalus and phalanges. That these remains belonged to a small animal is indicated by the size of the vertebræ:

	M.		M.
Length of centrum of sharp keeled dorsal.....	0.014	of rounded dorsal.....	0.012
Depth behind.....	0.012		0.011
Width behind.....	0.012		0.0105.

Cope says of *Clepsydrops:* "This genus is more typically Rhynchocephalian than *Cricotus*," not knowing at that time that *Cricotus* is one of the *Stegocephali* (*Labyrinthodonta*).

The next communication was made by Cope[2] in 1877. *Clepsydrops* is now placed definitely among the *Rhynchocephalia*. *Clepsydrops collettii* Cope is said to be the most abundant land vertebrate of the formation, being represented in all the collections, sometimes by portions of individuals of double the size of the type. There is a single occipital condyle. Two new species of *Clepsydrops* are described, *C. vinslovii* and *C. pedunculatus*.

C. vinslovii Cope is based on a third cervical vertebræ, and probably represented by other vertebræ. *C. pedunculatus* Cope is established on a third cervical and another, apparently dorsal one. This species is said to be characterized by the stronger diapophyses.

Teeth are described, Species No. 4, p. 56, and are referred to *Clepsydrops collettii*. The horizon from which the fossils came is now considered as Permian, and is named the *Clepsydrops shale*.

In the same year the discovery of Permian Reptiles in Texas was announced by Cope,[3] and other remains from Illinois are described. *Lysorophus tricarinatus* Cope is named and described. "Vertebræ amphicœlian, perforated by the foramen chordæ dorsalis. Neural arch freely articulated to the centrum. Floor of neural canal deeply excavated. No processes nor costal articulations on the centrum, which is excavated by longitudinal fossæ. Centrum not shortened." From near Danville, Illinois. Based on two centra and a portion of a third. Another new genus and species is based on teeth: *Archæobelus vellicatus*, "Species No. 4," Cope, *Proc. Amer. Philos. Soc.*, 1877, p. 192.

A new species of *Clepsydrops, C. limbatus,* is described from Texas. It is based on a vertebra with the following dimensions:

		M.
Length of centrum		0.031
Diameter of centrum	vertical	0.039
	transverse	0.033

In the May number of 1878 of the *American Naturalist,* published April 22, Cope[4] made some remarks about the homology of the chevron bones. He says: "The basal portions of the chevron bones are continued throughout the greater part of the vertebral column in the Permian genera *Clepsydrops, Metarmosaurus* and *Epicordylus* [*Eryops*], forming intervertebral elements to which I have given the name *intercentra*"—"The free elements of the cervical series of some reptiles are probably the same." Here the name *intercentrum* is introduced. In the same number of the *Naturalist* Cope[5] refers to *Clepsydrops:* "*Clepsydrops* has been found to have the canine and incisor teeth distinctly characterized. The ischia are immensely enlarged in an antero-posterior direction, forming a boat-shaped body.* The neural spines of the lumbar and sacral regions are greatly elevated, indicating a fin like that of *Basiliscus.*" Two new species are described, *C. natalis* and *C. gigas,* the latter of the size of the larger Mammalia.

In May, 1878, a paper by Prof. O. C. Marsh[6] appeared in the *American Journal of Science* on Permian fossils. In the beginning he states that "hitherto no Permian vertebrates have been identified in this country, although not uncommon in Europe."

He continues: "The Museum of Yale College contains an extensive series of Reptilian remains belonging to a peculiar lacustrine fauna, which includes also Amphibians and Fishes. These fossils are from several localities in the West, but mainly from New Mexico, and the geological horizon appears to be in the upper portion of the Permian. These Reptilian remains are in excellent preservation, and among them are several genera having the more important characters of the *Rhynchocephalia,* of which the genus *Hatteria,* of New Zealand, is the living type. The principal points of agreement are the separate premaxillaries, the immovable quadrate, and the biconcave vertebræ. Another character of much interest is the presence of certain hypaxial elements of the vertebræ, first observed by Von Meyer in the Triassic genus *Sphenosaurus,* and called by him intercentral bones ('*Zwischenwirbelbein*'). These wedge-shaped bones are apparently the homologues of the cervical hypapophyses in the *Mosasauria,* and of the subcaudal attachments in the *Odontornithes,* and a few recent birds. These intercentral ossifications apparently exist in all the Reptilia yet found in this new fauna, and hence serve to distinguish it. With this character is another of hardly less interest. The anterior rib-bearing vertebræ preserved have three separate articular facets for the ribs, one on the

* This pelvis probably belongs to Eryops.

anterior part of the centrum for the head, and a double one above for the bifid tubercle. In the implantation of the teeth and their successional development these Reptiles resemble the Mosasauria. These characters, with others mentioned below, indicate two distinct families, which may be called *Nothodontidæ* and *Sphenacodontidæ*, from the typical genera here described.

"*Nothodon lentus*, gen. et sp. nov.

"This genus of Reptiles may readily be distinguished by the dentition. In each separate premaxillary there are two slender pointed teeth. In front of the maxillary there are one or two similar teeth, followed by a number with narrow transverse crowns, resembling in form the premolars of some carnivorous mammals. These crowns, when unworn, have a central cusp, and on each side a tubercle, somewhat like that on the premolars of the genus *Canis*. In the present species the first and last of the transverse teeth are smaller than the middle ones. The limbs were short, the long bones had their extremities covered with cartilage, but the carpals and tarsals were well ossified. The centra were very deeply concave, and the tail was long.

"The following measurements are taken from the type specimen of this species:

	MM.
Length of maxillary bone	65·
Space occupied by ten maxillary teeth	55·
Height of crown of second maxillary tooth	14·
Height of crown of third maxillary tooth	9·
Antero-posterior diameter	3·
Transverse diameter	8·
Antero-posterior diameter of eighth tooth	5·
Transverse diameter	15·

"The present species was about five or six feet in length, and herbivorous in habit. It was apparently slow in movement, and probably more or less aquatic. The remains at present known are from New Mexico."

This is one of Cope's *Diadectidæ*.

"*Sphenacodon ferox*, gen. et sp. nov.

"In the present genus the anterior teeth are somewhat like those of the reptile described above, but the posterior, or more characteristic ones, are totally different. The crowns are much compressed, and have very sharp cutting edges, without crenulations. In the present species the carnivorous teeth are crowded together, and the crowns placed slightly oblique, and twisted. The jaws were comparatively short and massive. The

rami of the lower jaws were apparently united by cartilage only, and the symphysis was short. The vertebræ are deeply biconcave.

"Measurements from the type of this species are as follows:

	MM.
Length of dentary bone	150·
Space occupied by teeth	130·
Extent of four anterior caniniform teeth	25·
Extent of twenty compressed teeth	105·
Height above jaw of second lower tooth	15·
Depth of dentary bone at symphysis	26·
Height of crown of compressed tooth	8·
Transverse diameter	4·

"This reptile was about six feet in length, and carnivorous in habit. Its remains are from the same locality in New Mexico that yielded those of *Nothodon*."

This is probably one of the *Clepsydropidæ*.

"*Ophiacodon mirus*, gen. et. sp. nov.

"A third genus of Reptiles allied to the last described is indicated by various well-preserved remains from the same locality. The teeth are all carnivorous in type, conical in form, and all are similar. Those in the anterior part of the jaws are recurved, and in general shape resemble those of Serpents. The rami of the lower jaws were united only by cartilage. The vertebræ are very deeply biconcave, and even perforate, and the intra-central bones large. In the present species the teeth are nearly smooth, and somewhat compressed.

"The following measurements indicate the size of this reptile:

	MM.
Extent of anterior sixteen teeth in dentary	75·
Extent of anterior five lower teeth	20·
Height of crown of fourth lower tooth	10·
Depth of lower jaw at symphysis	15·
Extent of seven anterior maxillary teeth	33·
Height of crown of first maxillary tooth	9·
Antero posterior diameter of crown	3·

"This species was about as large as those described above, and is from the same geological horizon in New Mexico.

"*Ophiacodon grandis*, sp. nov.

"A second larger species of apparently the same genus is represented by portions of the jaws, and teeth, and various parts of the skeleton. In this species the dentary bone is angular at its anterior extremity, and triangular in section. Its external surface is

rugose, as in the Crocodiles. The crowns of the teeth are striate at the base, and the latter is furrowed vertically. The teeth are not so thickly set as in the smaller species, and the bases of the crowns are somewhat transverse.

"*Measurements.*

	MM.
Space occupied by ten anterior lower teeth	140
Depth of lower jaw at symphysis	129·
Antero-posterior extent of symphysis	25·
Depth of dentary bone below seventh tooth	30·
Width of dentary at this point	20·

"The present species was about ten feet in length, and the largest reptile yet found in this fauna. The remains are from New Mexico."

The *Ophiacodon mirus* is one of the Clepsydropidæ, and *O. grandis* might be *Eryops* Cope.

The families "*Nothodontidæ*" and "*Sphenacodontidæ*" are, like the genera, established without diagnosis.

To this paper Cope[7] replied in *The American Naturalist*, June, 1878. He says that the four species of reptiles are characterized by Marsh in a very insufficient manner. He should not regard his article as suitable for notice in *The Naturalist* but for certain assertions which it contains, and some circumstances connected with its publication. The assertion that "hitherto no Permian vertebrates have been identified in this country, although not uncommon in Europe," he declares the reverse of the fact, referring to his paper in the *Proceedings of the Academy of Natural Sciences of Philadelphia* for 1875, pp. 393–424, where some of the leading characters of the reptiles are pointed out; to his papers in the *Proceedings of the American Philosophical Society* for May, 1877, pp. 52–63, where several new species are described, and in the same journal for November, 1877, in which other species are added, making the whole number up to twenty-one. He then continues: "These papers Prof. Marsh has had the opportunity of seeing. Two further notices of the vertebrates of the American Permian appeared on April 22, of the present year (1878), in the May number of this journal, pp. 319 and 327. As the corresponding number of the *Am. Journ. Sci. and Arts* was not issued before May 5 (perhaps a day or two sooner), Prof. Marsh had the opportunity of seeing these also. They include references to seven new genera, for most of which the characters are clearly pointed out.

"The features common to the genera of the Permian, described by Marsh, are stated by him to be those characteristic of the order *Rhynchocephalia;* as I have already shown to be the case with the forms described by me in the earliest as well as later papers of those

cited. Another characteristic is said to be the presence of the intercentrum, a statement agreeing with my own in the May number of this journal.

"As the author of the paper does not think it necessary to allude to published sources of information, it is too much to expect him to give credit for ideas communicated to him verbally. *All* of the above mentioned and additional characters cited by Marsh in his two opening paragraphs as belonging to the Permian Reptiles, with others, were explained by me before the National Academy of Sciences, with Prof. Marsh as an attentive listener, at its last meeting in Washington, April 18, more than two weeks before the appearance of the paper here criticised. The characters to which I refer are 'the separate premaxillaries, the immovable quadrate and the biconcave vertebræ;' the 'hypaxial elements of the vertebræ, called [by von Meyer] intercentral bones.' 'These intercentral ossifications apparently exist in all the Reptilia yet found in this new fauna.' Compare these statements with those found in my paper read before the National Academy (which had been previously read before the American Philosophical Society, April 5) and published May 8, and that Prof. Marsh profited by what he heard is evidenced by his use of the term 'intercentra,' first introduced by myself. From this point of view it is easy to understand his attempt to make it appear that Meyer first used the word. He says, 'Another character of much interest is the presence of certain hypaxial elements of the vertebræ, first observed by von Meyer in the Triassic genus *Sphenosaurus*, and called by him intercentral bones (Zwischenwirbelbein)' (*sic*). 'As *Zwischenwirbelbein* does not mean intercentrum, but *intervertebral bone*, Prof. Marsh's knowledge of the former term must be ascribed to some other source. The fact that the *Amer. Journ. Sci. and Arts* appeared a good deal later than its usual date of publication may be considered in this connection."

On May 8, 1878,[8] appeared the first more extensive paper of Cope on the forms from the Permian of Texas. The following new genera and species were described: *Diadectes sideropelicus* and *D. latibuccatus*; *Bolosaurus striatus* and *B. rapidens*; *Pariotichus brachyops*; *Ectocynodon ordinatus*; *Dimetrodon incisivus*; *D. rectiformis* and *D. gigas*; *Epicordylus erythrolitieus*; *Metarmosaurus fossatus*; *Empedocles alatus*; *Embolophorus fritillus*; *Theropleura retroversa*, *T. uniformis* and *T. triangulata*. A new species of *Clepsydrops*, represented by numerous portions of the skeleton, was established—*C. natalis*. The skull is described: "There is no quadratojugal arch, but the zygomatic and postorbital arches are present. The squamosal extremity of the zygomatic arch descends low on the quadrate as in turtles, preventing mobility of the latter." "The symphysis of the mandible is short, and the premaxillary bones appear to be distinct. The teeth were of different sizes and the premaxillaries and canines are distinguished from the others by their proportions. All are subround in section, with more or less defined anterior and posterior cutting edges. The premaxillary teeth are larger anteriorly, diminish pos-

teriorly, and are separated by a notched diastema from the large canine. The succeeding teeth are of medium proportion. There is no surface sculpture of the cranial bones." The vertebrae and intercentra, the greatly elevated neural spines in the lumbar and sacral regions are described, the humerus with the entepicondylar foramen and the ectepicondylar groove. The ilium, ischium and femur. In regard to the relationship of *Clepsydrops*, Cope makes the following remarks: "Of the general affinities of this genus it is only necessary now to state, that my reference of it to the *Rhynchocephalia* is confirmed. It differs from the recent species of the order in the absence of quadratojugal arch and the remarkably developed ischia. On this account I refer to *Clepsydrops* and its allies as a distinct suborder under the name of PELYCOSAURIA."

The new genus *Dimetrodon* is larger than *Clepsydrops*. The dentition is similar to that genus. The roots of the teeth are long and are contained in deep alveoli. Between the premaxillary and maxillary is a deep emargination of the border of the jaws. There are but two incisor teeth, of which the anterior is much larger than the second. The anterior two teeth of the maxillary bone are larger than the following ones, the anterior exceeding even the first incisor. The other maxillary teeth are smaller and subequal. The orbit is lateral, and has a prominent and convex supereiliary border. The zygomatic arch is so curved upwards as to complete the orbit behind by the intervention of a postorbital or postfrontal bone, which separates the malar [jugal] and squamosal bones from mutual contact. In front of this bone a portion of the frontal forms the supereiliary border, and in front of this, the prefrontal sends a wide process behind the lachrymal to the orbit. This bone resembles a nasal bone in form, and extends forward, and is decurved at the extremity. The width of the descending or malar process of the postfrontal is such as to partially separate the orbit from the zygomatic fossa. The supereiliary surface is swollen, and is interrupted by a transverse groove on the orbital part of the prefrontal. There is a vertical open groove on the malar process of the postfrontal. Some pelvic bones are referred here. They include both the ilia, ischia and pubes in one mass, forming a compressed boat-shaped body, with a prominent inferior keel. They probably belong to *Eryops*.

Dimetrodon is said to be allied to *Deuterosaurus* Eichw. and *Eurosaurus* Fisch., as defined by Meyer. "*Deuterosaurus* has much more elevated nostrils, more numerous incisor teeth, and wants the extensive diastema in front of the superior canine. *Lycosaurus* Owen, from the South African Trias, resembles it much more nearly, but does not present the greatly enlarged anterior incisor teeth of *Dimetrodon*."

The new genera and species, *Epicordylus erythrolitieus* Cope and *Metarmosaurus fossatus* Cope, which are based on vertebrae, are considered closely related to *Dimetrodon*. The new genera, *Embolophorus*, with one species, *E. fritillus*, and *Theropleura*, with

three species, *T. retroversa*, *T. uniformis* and *T. triangulata*, all based on vertebræ, are also placed near that genus.

A peculiar genus, *Empedocles* [*Empedias*] *alatus* Cope, with additional hyposphene and hypanthrum articulations, is also described.

In addition to the type of humerus referred to *Clepsydrops*, Cope describes three other humeri, which represent three other genera which have been probably already named from crania or vertebræ. Nos. 1 and 2 are compared with that of *Eurosaurus*, but the epicondyles are more largely developed. No. 3 is considered as belonging to *Empedocles* [*Empedias*].

Prof. Cope concludes his paper with the following remarks: "The division *Pelycosauria* is established primarily on the genera *Clepsydrops* and *Dimetrodon*, but their cranial structures render it highly probable that *Eetocynodon*, *Pariotichus* and *Bolosaurus* belong to it. It is also probable that the genera, *Empedocles* [*Empedias*], *Embolophorus* and others determined from vertebræ belong to it, as the latter are frequently accompanied by pelvic bones of the type of that of *Dimetrodon*. All the genera known from teeth and crania are of carnivorous habit, excepting Bolosaurus and Diadectes; they may be referred to a single family on this account, which I call the *Clepsydropsidæ*. *Bolosaurus* will form the type of another family characterized by the transverse position of the crowns of the teeth, under the name of *Bolosauridæ*. Prof. Owen has named a group of Triassic and Permian reptiles the *Theriodonta*, characterized by the mammal-like differentiation of the incisor and canine teeth. The animals thus referred by Prof. Owen probably enter my suborder of *Pelycosauria*, although the structure of their pelvis remains to be ascertained. If so, they correspond with my *Clepsydropsidæ*, since Prof. Owen does not include herbivorous forms in his division. As it is plain that the herbivorous and carnivorous types belong to the same order, and probably suborder, it becomes necessary to subordinate the term *Theriodonta* to that of *Pelycosauria*. To another division of reptiles from the South African Trias, typified by the genus *Pareiasaurus* Owen, he gives a special name, expressive of the deeply impressed surfaces of the centra occupied by the remains of the *chordæ dorsalis*. As this, or the perforate condition, is characteristic of all of the *Pelycosauria*, it is probable that it is present in Prof. Owen's *Theriodonta* also. It is also evident that since the dental characters of *Pareiasaurus* do not serve to distinguish it as an order from the genera with distinct canine teeth, this group also must be looked upon as a subdivision, perhaps of family value, of the *Pelycosauria* or other parts of the Rhynchocephalous order."

In regard to the geological formation of the Illinois and Texas beds, he comes to the conclusion that they are Permian.

On the 7th of November, 1878, Prof. Cope[9] read a paper before the National Acad-

emy of Sciences, at its meeting in New York, on the *Theromorphous Reptilia.* "He stated that he had determined that the scapular arch in the *Pelycosauria* consists of scapula, coracoid and epicoracoid, which form a continuum in the adult, in the same way as the three elements of the pelvis in the same group form an os innominatum. He showed that the tibiale and centrale of the tarsus unite to form an astragalus, which has no movement on the tibia. The fibulare forms a calcaneum. The distal side of the astragalus presents two facets, one of which receives a large part of the proximal extremity of the cuboid.

"The structure of the scapular and pelvic arches was stated to be identical with that already described by Owen as belonging to the *Anomodontia.* Several important characters distinguish this group from the *Pelycosauria,* but the two together form an order, which Prof. Cope thought would have, for the present at least, to be retained as distinct from the *Rhynchocephalia.* The characters of this order, with its two suborders, were given as follows:

"THEROMORPHA Cope. Scapular arch consisting at least of scapula, coracoid and epicoracoid, which are closely united. Pelvic arch consisting of the usual three elements, which are united throughout, closing the obturator foramen [f. pubo-ischiaticum] and acetabulum. Limbs with the phalanges as in the ambulatory types. Quadrate bone proximally united by suture with the adjacent elements. No quadratojugal arch.

"*Pelycosauria.* Two or three sacral vertebræ; centra notochordal; intercentra usually present. Dentition full.

"*Anomodontia.* Four or five sacral vertebræ; centra not notochordal; no intercentra. Dentition very imperfect or wanting.

"The *Rhynchocephalia* have no distal ischio-pubic symphysis, and apparently no epicoracoid bone. They have an obturator foramen [foramen pubo-ischiaticum] and a quadratojugal arch.

"The order *Theromorpha* was regarded by Prof. Cope as approximating the *Mammalia* more closely than any other division of *Reptilia,* and as probably the ancestral group from which the latter were derived. This approximation is seen in the scapular arch and humerus, which nearly resemble those of the *Monotremata,* especially *Echidna;* and in the pelvic arch, which Owen has shown in the *Anomodontia* to resemble that of the Mammals, and, as Prof. Cope pointed out, especially that of *Echidna.* The tarsus is also more mammalian than in any other division of reptiles. In the genus *Dimetrodon* the coracoid is smaller than the epicoracoid, as in Monotremes. The pubis has the foramen for the internal femoral artery."

At the end of this note a new species of *Dimetrodon* is described under the name of *D. cruciger.* "It is characterized by the enormous length of the neural spines of the

lumbar vertebræ, which form the dorsal fin seen in other species of the genus. In this species the spine sends off, a short distance above the neural canal, a pair of opposite short branches, forming a cross. At various more elevated positions there are given off tuberosities, which alternate with each other." This species of *Dimetrodon* was later made the type of *Naosaurus* Cope.

Cope's "Second Contribution to the History of the Vertebrata of the Permian Formation of Texas"[10] appeared June 5, 1880. The general conclusions about the *Theromorpha* he had already published in the *American Naturalist*, December, 1878, which we have reviewed above. Cope now believes that the *Pelycosauria* are related to the *Amphibia* in some important respects (scapular and pelvic arches, humerus, dentition of palatal region), but he says: "In spite of these approximations, the *Pelycosauria* are distinctly reptilian in their single occipital condyle, ossification of the basi-cranial axis and single vomer."

"Thus the reptiles and batrachia of the Permian period resemble each other and the *Mammalia* more closely than do the corresponding existing forms."

The genus *Theropleura* is more fully defined from a better preserved specimen of *Theropleura uniformis* than any so far obtained. "The teeth are generally similar to those of *Clepsydrops* and *Dimetrodon*, having compressed crowns with fore and aft cutting edges. The incisors are distinguished by the presence of a diastema. Posteriorly to this the teeth increase in size and then diminish; one tooth near the middle of the series is the largest, but does not in this species very much exceed the others. There is at least one large incisor tooth. The bones of the head are smooth and not sculptured. The symphysis of the mandible is short." The neural arches are distinct from the centra. Intercentra are said to be absent in the thirteen vertebræ preserved; but there was probably one below the centrum of the atlas. The ribs are two-headed, the capitular process extending downwards to the anterior border of the centrum. The neural spines of some of the vertebræ are greatly elevated, as in the species of *Clepsydrops* and *Dimetrodon*. Dermal rods are said to be present, suspected to be abdominal, and this is considered a batrachian character. The neural spine of the axis is extended fore and aft. The odontoid is distinct and is of large size. It has lateral and inferior articular surfaces.

Theropleura uniformis is described to be of the size of the larger *Varanidæ*, and about equal to the *Clepsydrops natalis*. It is characterized by a long and acuminate head, with a large lateral nostril on each side, well forwards and approaching near the border of the diastema. Anterior to the large lateral tooth there are nine teeth; posterior to it there are eighteen. Length of alveolar edge of mandible 0.120 m.

A new species of *Theropleura* is described as *T. obtusidens*, represented by nearly

all parts of the skeleton, including jaws of both sides with teeth, numerous vertebræ and bones of the limbs.

The neural arches are coössified with the centrum. The jaws are long and slender and the teeth are of equal size. The number of teeth in the dentary is about twenty-one. The mandibular articular face consists of two open parallel grooves, one shorter than the other, extending obliquely to the long axis of the jaw. A dentigerous bone of the palate is described.

The vertebræ have simple elongated neural spines. Intercentra are indicated by the shape of the vertebræ, but not preserved. Traces of sutural articulation with the neural arches remain. Many of the centra are much compressed and have a narrow, sharp median keel.

Dimetrodon is more fully described; the vertebræ and a portion of the muzzle are figured. Parts of the palatopterygoid are described, probably pieces of the palate and pterygoid; both bear teeth. The posterior part of the skull displays typical reptilian characters. The occipital condyle is described as not perforated nor divided by sutures. The exoccipital bones [paroccipital processes] project well backwards. The lateral walls of the brain-case are massive as far forwards as the exit of the fifth pair of nerves; anterior to this point they were thin or wanting. The basisphenoid carries two parallel descending laminæ, which bound a deep median fissure, and then unite anteriorly. Posteriorly they abut on a descending process, which is followed by a lid-like element which is applied to a circular fossa with a raised border near the occipital condyle.

The articular face of the articular bone of the mandible consists of two parallel cotyli, divided by a ridge of articular surface. [This is the quadrate.] This part of the jaw is much depressed, as in *Eryops*. The large teeth of the lower jaw are at the anterior extremity. The neural spine of the axis is flat and elongate antero-posteriorly. From this point the neural spines rise rapidly in elevation until on the dorsal region they are many times as long as the diameters of the centra. Intercentra are present in the dorsals; and all the ribs are two-headed, from the axis. All the cervical and dorsal vertebræ have diapophyses with tubercular facets. The head of the rib is prolonged downwards and forwards to the prominent border of the anterior articular face, against which it abuts, but so far as yet observed without a corresponding facet. [The facet is on the intercentrum.] On the caudal vertebræ the two facets of the ribs are approximated and finally are not distinguished. They are here coössified with the centra. Then follow short notes on humerus, pelvis and femur.

Three species are distinguished as follows:

Vertebral centra much compressed, acute below; neural spines without processes.....*D. incisivus.*
Vertebral centra less compressed, obtuse below; neural spines without processes, larger.....*D. gigas.*
Vertebral centra compressed, not acute below; neural spines with cross projections.....*D. cruciger.*

The characters of *Dimetrodon cruciger* Cope, already given in *American Naturalist*, December, 1878, p. 830, are noted again.

A new genus *Helodectes* is established. It has the molar teeth in two series. Two species are named *H. paridens* and *H. isacii.*

In the *American Naturalist* of February, 1881, Prof. Cope[11] gave a list of the Vertebrates of the Permian Formation of the United States.

The following *Reptilia* are catalogued:

THEROMORPHA Cope.

Pelycosauria Cope.

Diplocaulidæ.
Diplocaulus salamandroides Cope, Eastern Illinois.
Clepsydropsidæ.
Pariotichus brachiops Cope, Texas.
Ectocynodon ordinatus Cope, Texas.
Archæobelus vellicatus Cope, Eastern Illinois.
Clepsydrops collettii Cope, Eastern Illinois.
" *vinslovii* Cope, Eastern Illinois.
" *pedunculatus* Cope, Eastern Illinois.
" *natalis* Cope, Texas.
Dimetrodon incisivus Cope, Texas.
" *rectiformis* Cope, Texas.
" *biradicatus* Cope, Texas.
" *gigas* Cope, Texas.
" *cruciger* Cope, Texas.
Theropleura retroversa Cope, Texas.
Theropleura uniformis Cope, Texas.
" *triangulata* Cope, Texas.
" *obtusidens* Cope, Texas.
Metarmosaurus fossatus Cope, Texas.
Embolophorus fritillus Cope, Texas.
Lysorophus tricarinatus Cope, Eastern Illinois.
Bolosauridæ.
Bolosaurus striatus Cope, Texas.
Diadectidæ.
Diadectes sideropelicus Cope, Texas.
" *phaseolinus* Cope, Texas.
Empedocles alatus, Cope, Texas.
" *latibuccatus* Cope, Texas.
" *molaris* Cope, Texas.
Helodectes paridens Cope, Texas.
" *isacii* Cope, Texas.

The next paper of Cope[12] is "On Some New Bratrachia and Reptilia from the Permian Beds of Texas." A new species of *Dimetrodon* is described under the name of *D. semiradicatus;* based on premaxillary and maxillary bones. There are three teeth on each premaxillary; in the maxillary 17 or 18. The first premaxillary and third maxillary are of nearly equal size and are much larger than the others, the second premaxillary only approaching them. Besides, the clavicles of *Dimetrodon cruciger* are discussed and compared with the corresponding elements of the *Stegocephali.*

In November, 1884, Prof. Cope[13] published his fifth contribution to the knowledge of the Permian Vertebrates. A new species of *Clepsydrops, C. leptocephalus,* is described. "This species is represented by almost the entire skeleton, the principal deficiency being that of the scapular arch and the anterior limbs, with the phalanges of the posterior feet."

The bones of the skull are mostly preserved. The *quadrate* bones are rather short, and articulate above by squamosal suture with the squamosals, which overlap them pos-

teriorly. They narrow upwards, and are deeply grooved on the anterior face below. Each edge of the groove is produced forwards; the external for a considerable distance as an acuminate laminiform process, in the usual position of a quadratojugal bone. The *pterygoids* were probably placed much as in *Empedias molaris* Cope (*Proc. Am. Philos. Soc.*, Vol. xix, p. 56, Pl. V). They send inwards a subtriangular plate from each side, which approach each other on the median line without touching, and the adjacent edges are somewhat decurved. The posterior edges are deeply concave on each side of the middle line, and, like the inferior edges, are dentigerous. The process for the quadrate extends outwards and backwards, and is thickened on its posterior edge, while its anterior edge, which is continued from the inferior edge of the posterior border, becomes very thin. The anterior production for the ectopterygoids extends outwards and forwards, leaving the anterior edge of the dentigerous plates as the concave posterior border of the large palatine foramina. The anterior production of the internal edge of the plate becomes very thin, and is broken in the specimen without showing articulation for the palatine.

The *squamosal* extends both above and below its anteriorly directed zygomatic portion. The superior extremity shows squamosal suture for the parietal. The *stapes* (Pl. I, Fig. 2, a, b, c, d) is of large size. It consists of a stout rod terminating in a double extremity, something like the double head of a rib. The shorter head is expanded into a funnel shape. Near to it the shaft is perforated in the longer diameter by a foramen. The extremity of the other head is transversely truncate, and is separated from the funnel by a deep notch. On the outer side of the fundus of this notch a foramen penetrates the shaft obliquely, and is continued into a canal which issues at the foramen first described. The distal end is truncated by an irregular sutural surface. The premaxillaries are distinct. The teeth of that bone and of the maxillary are of unequal size.

The axis has an expanded neural spine and a diapophysis for rib articulation, but no parapophysis or capitular fossa. Behind the axis follow twenty-six vertebræ in a continuous series. All bear diapophyses, and all are rib-bearing, except perhaps the last two, where they are of reduced size. They are more or less opposite the neural canal as far as the twenty-second centrum. On this centrum the superior edge is on a level with the floor of the canal, and posterior to this point the diapophyses rise from the centrum. Two sacrals and ten caudals are preserved. The intercentra are short and not extended upwards on the sides. The neural spines were probably not elongated, as in *Dimetrodon*, though they are unfortunately broken off.

A new species of *Clepsydrops*, *C. macrospondylus*, is described, much exceeding *C. natalis* in dimensions. The dentary bone supports one or two large teeth near the extremity. There are preserved the axis, twelve continuous dorsals, nine other continuous vertebræ, of which three are lumbar, two sacral, and four caudal. Intercentra are

present. The centra are strongly compressed, and on the anterior part of the column have an obtuse hypophysial keel. The intercentra display equal width on the inferior surface, and are abruptly rounded at the extremities. The last one preserved is between the second and third caudal centra. The sacrum is rather robust. The sacral vertebræ are free, have well-developed neural spines and large free ribs for the ilium.

A new species of *Edaphosaurus, E. microdus,* is described. The genus *Edaphosaurus* was established on *E. pogonias,* represented by a specimen, which included only a distorted cranium. The new species is based on numerous vertebræ and ribs and the dentigerous plates of both jaws. The vertebræ possess enormously elongated neural spines as in *Dimetrodon.* The centra have a facet on the anterior edge above the middle for the head of the rib, as in a mammal. It is not repeated on the posterior edge of any of the thirteen centra preserved. The ribs are only compressed proximally. Distally their section is a wide oval.

The centra are rather elongate, and the *foramen chordæ dorsalis* is rather large. No intercentra are preserved, and if present they must have been very small, as the inferior rim of the centrum is not beveled to receive one. The neural spines have transverse processes which commence near the base, and project at intervals from the sides.

A special portion of the paper treats the *posterior foot* in the *Pelycosauria* (*Clepsydrops natalis,* Pl. I, Figs. 5, 6).

The astragalus and calcaneum are large and well-specialized bones free from each other and the other tarsal elements. The navicular is distinct. There are four tarsals in the distal series. Three are articulated with the metatarsals 1 to 3, the fourth with metatarsal 4 and 5. These elements are tarsal 1 (entocuneiform), tarsal 2 (mesocuneiform), tarsal 3 (ectocuneiform), and tarsal 4 and 5 (cuboid). There is a face on the astragalus for another element, which Cope thinks might have been a spur, as in the Monotremata.

The following conclusions are reached:

"1. The relations and number of the bones of the posterior foot are those of the Mammalia much more than those of the Reptilia. 2. The relations of the astragalus and calcaneum to each other are as in the Monotreme *Platypus anatinas.* 3. The articulation of the fibula with both calcaneum and astragalus is as in the Monotreme order of mammals. 4. The separate articulation of the anterior part of the astragalus with the tibia is as in the same order. 5. The presence of a facet for the articulation of a spur is as in the same order. 6. The posterior-exterior direction of the digits is as in the known species of Monotremeta."

"Thus the characters of the posterior foot of the *Pelycosauria* confirm the evidences of Monotreme affinity observed by Prof. Owen and myself in the bones of the legs,

especially of the anterior leg. It remains a fact that with this resemblance in the leg there is a general adherence to the reptilian type in the structure of the skull." But this adherence is not so exclusive as has been supposed, as he endeavors to show.

An account is now given of the structure of the *columella auris* in *Clepsydrops leptocephalus*. The columella resembles a rib, of which the suprastapedial process resembles the head, and the stapes the tubercle. If this process be the incus, the stapes is shortened as in the majority of *Mammalia*. We have here an approximation to the *Mammalia* in two points: (1) The perforation of the head of the stapes; (2) and the ossification of the incus, which (3) is distinct from the malleus, thus furnishing homologues of the principal ossicles of the ear.[14]

The structure of the quadrate bone in the genus *Clepsydrops* is then discussed. This bone in *Clepsydrops leptocephalus* Cope, already described, is of highly interesting form. Its lower horizontal process is homologized with the zygomatic process of the squamosal bone of the *Mammalia*, forming with the malar bone the zygomatic arch. "*In the Pelycosauria there is but one posterior lateral arch*, as is demonstrated by many specimens; hence, we have here a reptile with a zygomatic arch attached to the distal extremity of the quadrate bone."

After this some remarks follow about *the articulation of the ribs in Embolophorus*. "The ribs of the Theromorpha are two-headed. While the tubercular articulation has the usual position at the extremity of the diapophysis, the capitular is not distinctly, or is but partially indicated, on the anterior edge of the centrum, in Clepsydrops and Dimetrodon. In *Embolophorus*, as shown in 1878, the capitular articulation is distinctly to the intercentrum." Therefore the ribs of the *Theromorpha* are intercentral and not central elements, and are homologues, according to Cope, of the chevron bones [!]. This type of rib articulation also *approximates closely that of the Mammalia*, where the capitular articulation is in a fossa excavated from two adjacent vertebræ.

Finally *the origin of the Mammalia* is discussed. *The Mammals are considered as the descendants of the Pelycosauria*, and a table shows the relations between the *Amphibia*, *Pelycosauria*, other *Reptilia*, and the *Mammalia*. The same results were published in the *Proc. Amer. Assoc. Adv. Science*,[15] Vol. xxxiii, pp. 471–482, 1 Pl., Salem, 1885, with the title, "The Relationships Between the Theromorphous Reptiles and the Monotreme Mammalia." In April, 1885, Prof. Cope[16] published a paper "On the Evolution of the Vertebrata, Progressive and Retrogressive." Here he derives all *Reptilia*, with the possible exception of the Ichthyosauria, from the *Theromorpha*.

In April, 1886, Cope[17] gave figures of the vertebræ of *Clepsydrops natalis* Cope. In June of the same year he established the genus *Naosaurus*, in a paper with the title,

"The Long-spined Theromorpha of the Permian Epoch."[18] Referring to *Dimetrodon* he says:

"The huge neural spines formed an elevated fin on the back. In a medium-sized specimen of *Dimetrodon incisivus*, where the vertebral body is 35 mm. in length, the elevation of the spines is 900 mm., or twenty and a half times as great. The apex of the spine in this species is slender, and apparently was flexible. The utility is difficult to imagine. Unless the animal had aquatic habits, and swam on its back, the crest or fin must have been in the way of active movements. Accordingly the spines are occasionally found distorted at the union of the faces of fractures. The limbs are not long enough nor the claws acute enough to demonstrate arboreal habits, as in the existing genus *Basilicus*, where a similar crest exists. A very peculiar species has been described under the name of *Naosaurus claviger* Cope. There the spines are not quite so elevated as in the *D. incisivus*, but they are more robust, and have transverse processes or branches which resemble the yardarms of a ship mast. In a full-sized individual the longest cross-arms, which are the lowest in position, have an expanse of 260 mm., or ten and a quarter inches, while the spine has about the height of 500 mm. (19.75 in.), the body being 60 mm. long. The animal must have presented an extraordinary appearance. Perhaps its dorsal armature resembled the branches of shrubs then, as they do now, and served to conceal them in a brushy or wooded region; or, more probably, the yardarms were connected by membrane with the neural spine or mast, thus serving the animal as a sail with which he navigated the waters of the Permian lakes. A very singular character of the spines in all the species is that they are hollow, as in Cœlacanth fishes, and that the central cavity is not closed at the apex.

"There is a well-preserved cranium of the *D. claviger*, but the muzzle is unfortunately wanting. The median line rises forward so that the convexity of the top of the muzzle is higher than the posterior parts of the skull, whose profile descends rapidly. This throws the orbit far back, and gives the animal a peculiar appearance. *Naosaurus* differs from *Dimetrodon* in the transverse processes of the neural spines of the vertebræ. There are three species, which differ as follows:

Spines of vertebræ cylindrical distally; transverse processes replaced above by tuberosities ..... *N. cruciger.*

Spines of vertebræ expanded and compressed above. Palatine teeth large, forming a pavement..... *N. microdus* (*Edaphosaurus microdus* Cope).

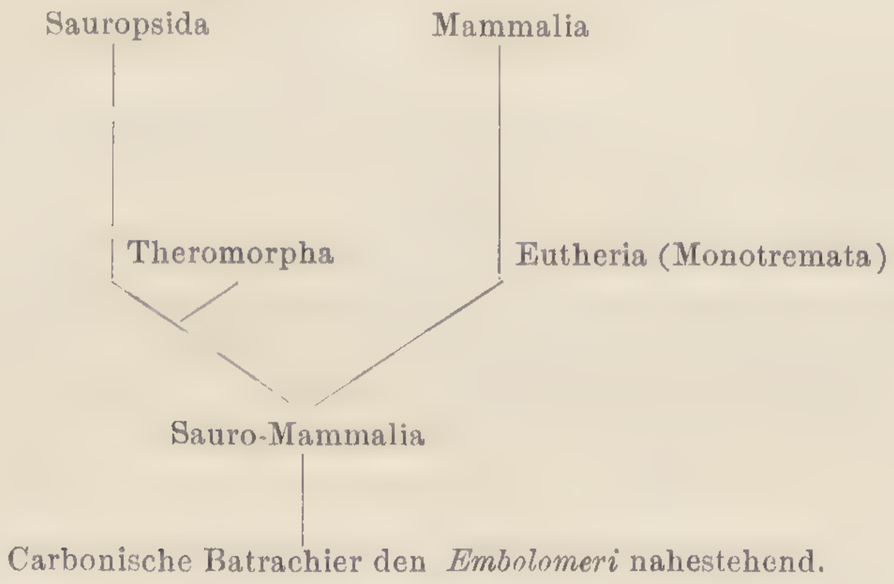
Palatine teeth much smaller and more widely spaced..... *N. claviger.*

"All these species are from the Permian formation of Texas."

In a paper by Baur[19] on the humerus of the Amniota, published in 1886, a few remarks are made on the relationship of the Theromorpha and the Mammalia. Baur

says: "Cope betrachtet die Pelycosauria als die Ahnen der Säugethiere. Ich glaube jedoch, dass dieselben schon etwas zu stark specialisirt sind, um diesen Anforderungen entsprechen zu können.

"Darüber aber kann kein Zweifel sein, dass die Pelycosauria den Stammaltern der Säugethiere sehr nahestehen. Beide sind vielleicht aus derselben Gruppe hervorgegangen, einer Gruppe, welche zwischen den Batrachiern und Reptilien des Perm in der Mitte stehen würde, und welche ich Sauro-Mammalia nennen möchte. Folgendes Schema möge den Zusammenhang ausdrücken:



A new catalogue of Permian vertebrates was published by Cope[20] in October, 1886.

Theromorpha.

Clepsydropidæ.

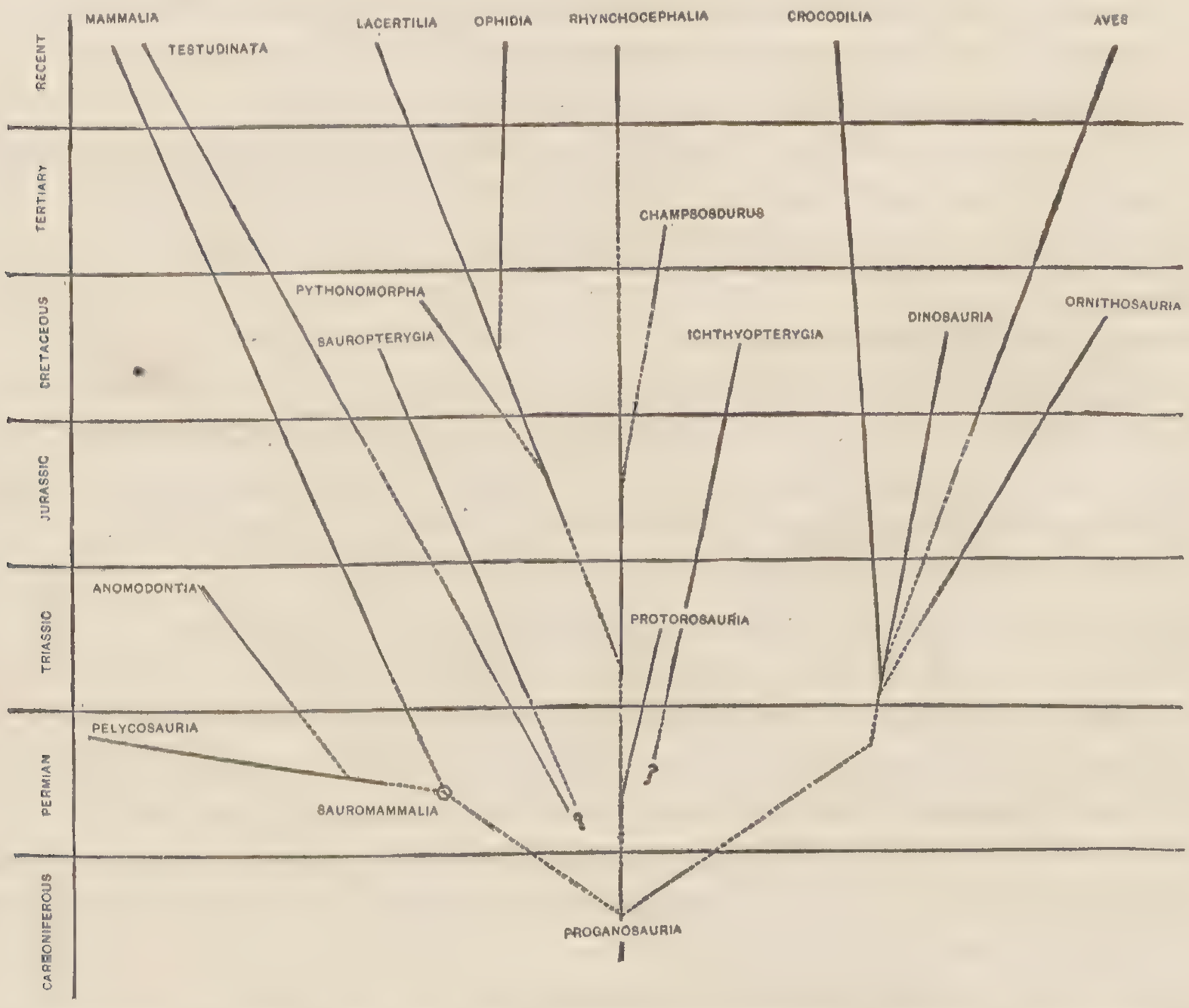
? *Lysorophus* Cope, 1877.
L. tricarinatus Cope, 1877, Eastern Illinois.
Archæobelus Cope, 1877.
A. vellicatus Cope, 1877, Eastern Illinois.
Clepsydrops Cope, 1875.
C. collettii Cope, 1875, Eastern Illinois.
C. vinslovii Cope, 1877, Eastern Illinois.
C. pedunculatus Cope, 1877, Eastern Illinois.
C. natalis Cope, 1878, Texas.
C. macropondylus Cope, 1884, Texas.
C. leptocephalus Cope, 1884, Texas.
[*C. limbatus* Cope, 1877, Texas, not mentioned]
Dimetrodon Cope, 1878.
D. gigas Cope, 1878, Texas.
D. incisivus Cope, 1878, Texas.
D. rectiformis Cope, 1878, Texas.
D. semiradicatus Cope, 1878, Texas.
Naosaurus Cope, 1886.
N. cruciger Cope, 1878 (*Dimetrodon*), Texas.
N. claviger Cope, 1886, Texas.
N. microdus Cope, 1884 (*Edaphosaurus*), Texas.
Theropleura Cope, 1878.
T. retroversa Cope, 1878, Texas.
T. uniformis Cope, 1878, Texas.
T. triangulata Cope, 1878, Texas.
T. obtusidens Cope, 1880, Texas.
Embolophorus Cope, 1878.
E. fritillus Cope, 1878, Texas.
E. dollovianus n. sp. Cope, 1886.
Edaphosaurus Cope, 1882.
E. pogonias Cope, 1882.

Remarks are made about *Dimetrodon* and *Naosaurus*.

"In a medium-sized specimen of *Dimetrodon incisivus*, where the vertebral body is 35 mm. in length, the elevation of the neural spine is 900 mm., or twenty and a half times as great." The interclavicle is described as *sternum* and figured Pl. III, Fig. 5. A posterior foot of *Theropleura* (spec. ?) is figured and described.

Naosaurus differs from *Dimetrodon* in the presence of transverse processes on the neural spines. Portions of the skull and vertebræ of *Naosaurus claviger* are described and figured (Pl. II, Figs. 1–3; Pl. III, Fig. 1). Vertebræ of *Naosaurus cruciger* and *N. microdus* are also figured (Pl. III, Figs. 2 and 3).

In 1887 Baur [21, 22, 23] gave the following diagram to express the relationship between the *Theromorpha*, the other Reptiles and the Mammals:



Lydekker in 1890[24] describes some Pelycosaurian remains from the Permian of Texas in his "Catalogue of the Fossil Reptilia and Amphibia in the British Museum," Part IV. 1. Pieces of the maxilla and neural spines of *Naosaurus cruciger* Cope. 2. Portions of spines of *Naosaurus claviger* Cope, and of undetermined species of *Naosaurus*. 3. Two dorsal vertebræ and an intervening intercentrum of *Embolophorus* spec. 4. Two dorsal

vertebræ and an intercentrum, and two other portions of dorsal vertebræ of *Embolophorus dolloverianus* Cope.

The next paper to be mentioned is by Prof. Cope,[25] "On the Homology of the Posterior Cranial Arches in the Reptilia," published in April, 1892.

Clepsydrops leptocephalus Cope is made the type of a new genus, *Diopeus* Cope. The following species have well-preserved crania which display sutures: *Chilonyx rapidens* Cope; *Pantylus cordatus* Cope; *Pariotichus megalops* Cope; *Edaphosaurus pogonius* Cope; *Clepsydrops natalis* Cope; *Naosaurus claviger* Cope; *Diopeus leptocephalus* Cope.

"The genera *Chilonyx*, *Pantylus* and *Pariotichus* have the temporal fossæ entirely roofed over, thus belonging to the *Cotylosauria*, to which must be probably referred the genus *Pareiasaurus* Owen, of the South African Karoo formation, and the *Phanerosaurus* of the German Permian. The other genera, excepting *Diopeus*, belong to the *Pelycosauria*, which is probably the same as the *Theriodontia* of Owen.

"*Chilonyx* agrees with the *Stegocephalia* and with other *Diadectidæ* in possessing a distinct *os intercalare* [*epiotic* aut.; *paroccipital plate*, Baur,[26] 1889; *os tabulare* or *tabular bone*, Cope,[27] 1894]. The component elements of the cranial roof are equal in number and similar in position to those of the Stegocephalian skull, except that the supramastoid [squamosal] extends between the parietal and intercalare [paroccipital plate] to the posterior border of the cranial table (Fig. 2, Sm.); and the supraoccipital does not extend on to the superior face of the skull, except as a narrow border. The quadrate bone is directed forwards instead of posteriorly, which causes an antero-posterior abbreviation of the supratemporal [prosquamosal] and squamosal elements. The elements of the temporal roof are not exclusively tegumentary, but are identical in character with the bones of the brain case, and the sutures are visible on the under as well as the upper side.

"*Pantylus* agrees with *Chilonyx* in the composition of its cranial roof with the exception that the suspensorium is vertical and is not directed forwards" (Fig. 4, Pl. I).

"*Pariotichus* Cope agrees in the main with *Chilonyx*, but the supraoccipital is divided medially and is reflected on to the superior face of the skull as in *Stegocephali*. The intercalare [paroccipital plate] is reduced to a small element, of which a small part appears on the superior face of the skull immediately behind the exterior part of the supramastoid" [squamosal] (Fig. 3, Pl. I).

Then it passes to the *Theriodontia* (*Pelycosauria*).

In "*Naosaurus* Cope (Fig. 7, Pl. II), the orbit is in the posterior part of the skull and the muzzle is greatly elevated and compressed [?]. The zygomatic (quadratojugal) is greatly decurved posteriorly and the supratemporal [prosquamosal] is accordingly decurved also. The postfrontal (Fig. 7a) is a narrow bone, wider than long, and it has connection with the frontal, parietal and postorbital only. The postorbital is an L-shaped

structure, of which the shorter limb is inferior, extending to the jugal, while the longer limb is posterior, extending to the supratemporal [prosquamosal], in contact with the parietal. It encloses no foramen with the latter; but it encloses a larger foramen with the jugal, zygomatic [quadratojugal] and supratemporal [prosquamosal] at the other boundaries. This is the infratemporal foramen of Baur. Posterior to the parietal is a small transverse element, which appears to be merely adherent to the former. Its determination is not easy at present. The supratemporal [prosquamosal] is elongate vertically, and narrow antero-posteriorly. Beneath and towards the middle line of the skull is a part of another bone which may be the paroccipital, or even exoccipital. The pineal foramen is distinct. No parietoquadrate arch."

"In *Clepsydrops* the structure is apparently the same, although the form is much less modified. The quadrate articulation is nearly in line with the maxillary dental series (Fig. 6, Pl. II), and the jugal is nearly horizontal; its inferior border being concave upwards. No bar extends posteriorly from the postorbital, which joins the supratemporal [prosquamosal], enclosing with it the infratemporal foramen. No indication of a supratemporal foramen can be found in the rather mutilated specimen. I think it was not present."

"In *Edaphosaurus* Cope (Fig. 5, Pl. II), the skull is of a more depressed type than in the preceding genera. The postorbital is mainly preserved, and it is in contact with the frontal proximally, and sends out no bar posteriorly. There was apparently no supratemporal foramen, but a very large infratemporal, which extended well upwards. There is no parietoquadrate arch. An element, perhaps supraoccipital, terminates in a free compressed apex on each side of the median posterior region. This may be homologous with the small free bone described in *Naosaurus*, in nearly the same position. The stapes is very large, and is at least partially perforated near the expanded proximal extremity. It is probably fully perforated, as I have described it in the *Diopeus leptocephalus* Cope."

"In *Diopeus* Cope, the supratemporal is elongate in the vertical direction, and as elsewhere it overlaps the quadrate at the distal extremity. Anteriorly, it sends forwards a process probably for union with the postorbital bone, which is, however, entirely free from the parietal, and encloses a foramen with it, precisely as in *Sphenodon*. It further resembles the corresponding element in *Sphenodon* in sending upwards a branch for union with the parietal. Thus there are in this genus two posterior bars and two foramina, thus differing widely from the other Permian genera of this or any other country known to me. Whether it has a free parietoquadrate arch I do not know, but it is probable that the genus should be referred to the *Rhynchocephalia*, in the neighborhood of *Palæohatteria* Cred. It differs from *Sphenodon* and resembles closely the *Theriodontia* in the absence of an obturator foramen, and in the character of its dentition. The zygomatic

bone [quadratojugal] is not excavated below, but has a straight outline to its junction with the jugal. The quadrate condyle is double like that of *Sphenodon* and the *Clepsydropsidæ*" (Fig. Pl. II).

"The *Theriodonta* described by Owen appear to have the single cranial arch constructed in the same way as I described above as characteristic of the American forms. I gather this from Owen's figures of the genera *Kistecephalus* Ow., *Galesaurus* Ow., *Scaloposaurus* Ow., *Anthodon* Ow., and apparently *Lycosaurus* Owen."*

The posterior region of the *Anomodontia* is then discussed. They possess an "extensive supratemporal foramen, and that the bone which bounds it externally consists posteriorly of the supratemporal bone [squamosal], and not the zygomatic [quadratojugal]. Anteriorly this bone joins the postorbital, postfrontal and malar" [jugal]. "It is evident then that the *Anomodonta* differ from the *Theriodonta* in the absence of a zygomatic [quadratojugal] arch, and in the presence of a supratemporal arch, which is separated from the parietal bone by a supratemporal foramen."

Prof. Cope thus reaches the conclusion that there are four types of crania represented in the Permian Reptilia, which he distinguishes as follows:

Temporal roof uninterrupted	*Cotylosauria.*
A zygomatic arch, but no distinct supratemporal or supramastoid arches	*Theriodonta.*
Zygomatic and supratemporal arches	*Diopeus.*
No zygomatic; a supratemporal arch	*Anomodontia.*

Discussing the *parietoquadrate arch*, Prof. Cope remarks: "The parietoquadrate arch is a later appearance in geologic time. It is not present in any of the Permian orders."

In 1897, Baur and Case[28] showed that the *Pelycosauria* possess two temporal arches, an upper postorbito-squamosal and a lower quadratojugal arch, besides the parietoquadrate arch. They also demonstrated that the *Pelycosauria* are specialized *Rhynchocephalia*, which die out during the Permian, and cannot be the ancestors of the *Mammalia*.

Shortly before his death, Prof. Cope[29] wrote a review of this paper with discussions, which was published in the *American Naturalist* of April, the last number he edited.

The Pelycosauria from the Permian of France.

The first remains of Permian Reptiles, which we consider as Pelycosaurian, were described in 1856 by Coquant,[30] and later redescribed and figured by Gervais.[31]

They consisted of an upper jaw of a Reptile, found near Moissey, which was considered by Coquant as belonging to *Protorosaurus*. It is preserved in the Museum of

**Procolophon* Ow. is also placed here.

Besançon. Gervais has examined these fossils and has given figures of them. "La pièce (Fig. 29) est longue de 0.065 m.; elle se compose d'un fragment considérable de la maxillaire gauche, portant une dent caniniforme suivie de huit cuitres dents plus petites et décroissantes dont la première est à quelque distance de celle qui par sa grandeur et sa forme peut être considérée comme une canine. Les dents sont comprimées, subcultriformes, très-faiblement striées longitudinalement, à bords antérieur et postérieur subtranchants, mais non denticulés en scie. Cette de ces dents qui occupe la position antérieure est aussi la plus grande et elle est comparable à une canine, distante de la première de celles qui suivent d'une longueur de 0.010. Sa hauteur, audessus du bord du maxillaire, est de 0.020, et sa longueur, à la base, de 0.007. La plus grande des dents qui la suivent n'a que 0.010 de fût. Les dents placées après celle-là vont en décroissant. On se rendfort bien compte de la disposition des dents placées en arrière de la canine et de leur grandeur décroissante par l'inspection de la contréempreinte du mème morceau (Fig. 30).

"On y voit, en avant de la canine, l'indice de quatre autres dents subégals entre elles, dont la quatrième, en comptant d'avant en arrière, est sensiblement écartée de la canine elle-même, comme l'est d'ailleurs la première des dents de l'autre série. Les dents étaient à peu près, triangulaires à leur couronne, et leur forme était assez peu différente de celle des dents placées en arrière de la canine. Les quatres empreintes de dents, celle de la canine et celles des huit dents qui suivent cette dernière, occupent ensemble, une ligne courb dont l'arc mesure 0.085."

Gervais denies the identity of this fossil with *Protorosaurus;* according to him it seems related to the *Geosaurs,* and he names it provisionally *Geosaurus* (?) *cynodus.*

It is evident that it is no crocodile; it can only be compared with the Pelycosauria. It seems to be different from *Stereorachis* Gaudry.

Stereorachis dominans Gaudry, 1880.

The genus *Stereorachis,* from the Permian of Autun, was first described by Gaudry[32] in 1880. A more complete account with figures appeared in 1883.[33]

Of *Stereorachis* the following remains are preserved: The lower jaw about 135 mm. long is in very poor condition; thirteen teeth are present, the most anterior one is the largest. The maxillary is partially preserved, exhibiting nine teeth, the two first ones being the largest. The vertebræ were deeply biconcave, with the notochordal canal persistent. The *clavicles* and the *interclavicle* are Pelycosaurian in shape. The interclavicle especially resembles that of *Dimetrodon* as figured by Cope. Remains of scapula and coracoid are present and a number of ribs. The *humerus* is also typically Pelycosaurian. Very fine abdominal ossicles are preserved, showing that some Pelycosauria had a ventral plastron like *Sphenodon, Palæohatteria* and *Kadaliosaurus.*

Gaudry did not make any remarks about the relationships of *Stereorachis*. Zittel[34] in 1888 placed it among the *Stegocephali*: "Unterordnung Stereospondyli. Vollwirbler, 1. Familie Gastrolepidoti, Bauchschupper." Lydekker[24, 35] was the first who gave the right position to *Stereorachis*, among the *Theriodontia* in the family *Clepsydropsidæ* Cope. Zittel[36] followed him in his Grundzügen der Paleontologie, 1895.

Callibrachion gaudryi, Boule and Glengeaud.[70]

Callibrachion is the name applied to a very nearly perfect specimen from the Permian of Autun. It has many of the features of the Permian Reptiles and was compared by the authors with the *Palæohatteria* of Credner. That it belongs among the *Pelycosauria* there is little doubt, though the presence of procœlus and opisthocœlus vertebræ is an unwonted character in the group, and if their presence is established in the specimen may lead to a revision of its position. The authors say of the specimen, p. 15: "Le *Callibrachion* a beaucoup plus d'affinités avec le Reptile du Rothliegende de la Saxe que M. Credner a appelé *Palæohatteria*. D'après ce qui est conservé de la tête de notre spécimen, nous pouvons croire que les crânes des deux animaux étaient fort ressemblants. La division de la mâchoire inférieure en plusieurs éléments, la forme des dents, leur ordre de distribution suivant le grandeur à la mâchoire supérieure, sont des traits communs. Dans les deux fossiles les centrums étaient séparés des arcs neuraux, dépourvóus d'apophyses transverses, et la notochorde persistait au centre des corps verté braux. Les pattes étaient également bien développées et disposées sur le même plan.

"Mais à la côté de ces ressemblances, nous pouvons notre quelques différences. Les vertèbres du *Callibrachion* présentent une procélie bien marquée et les premières vertèbres sont opisthocèles."

Pelycosauria from the Permian of Africa.

Owen[37] described in 1859 *Galesaurus planiceps* and *Cynochampsa laniaria* from the Beaufort Beds of the Karoo System and placed them in the family Crocodilia. In the final paper these Reptilian remains are figured but not referred to the Crocodilia. In the second edition of his *Palæontology* (1861) Owen[38] placed these two genera in a new, third family of the order *Anomodontia*, with the name *Cynodontia*. This is his classification:

Order *Anomodontia*.

1. Family *Dicynodontia*—*Dicynodon* Ow., *Ptychognathus* Ow.
2. Family *Cryptodontia*—*Oudenodon* Ow., *Rhynchosaurus* Ow.
3. Family *Cynodontia*—*Galesaurus* Ow., *Cynochampsa* Ow.

The family *Cynodontia* is thus characterized: "A pair of teeth in each jaw, resembling in shape, position and relative size to the other teeth, the canines of carnivorous mammals, and dividing the incisors from the molars."

Haeckel[39] in 1866 divides the *Anomodontia* into three families:

1. *Rhopalodontia—Rhopalodon*, Permian Russia.
2. *Dicynodontia—Dicynodon, Ptychognathus.*
3. *Cryptodontia—Udenodon, Rhynchosaurus.*

The order *Theriodontia* was established by Owen[40] early in 1876. It was to contain *Galesaurus* and *Cynochampsa* and the new South African genera *Lycosaurus, Tigrisuchus, Cynosuchus, Nythosaurus, Scaloposaurus, Procolophon, Gorgonops,* as well as the genus *Cynodraco.* He remarks:

"For the name of these extinct carnivorous *Saurians* I find it convenient and believe it will be generally acceptable to form a distinct order of Reptilia under the denomination of *Theriodontia,* with the following characters: Dentition of the carnivorous type; incisors defined by position, and divided from the molars by a large laniariform canine on each side of both upper and lower jaw, the lower canine crossing in front of the upper; no ectopterygoids; humerus with an entepicondylar foramen; digital formula of fore foot 2, 3, 3, 3, 3 phalanges."

In 1878 appeared Owen's *Catalogue of the Fossil Reptilia of South Africa.*[41] The Order *Theriodontia* is now defined in the following way:

"*Char.* Dentition of the carnivorous type; incisors defined by position, and divided from molars by a large laniariform canine on each side of both upper and lower jaws, the lower canine crossing in front of the upper as in Mammalia."

The *Theriodontia* are divided in three sections.

Section *Binarialia.*

The external nostrils are divided by a narrow partition; the entire skull has a compressed form.

Genera *Lycosaurus* Ow. Species *L. pardalis* Ow., *L. tigrinus* Ow., and *L. curvimola* Ow.
Tigrisuchus Ow. Species *T. simus* Ow.

Fam. *Mononarialia.*

In this family of *Theriodontia* the external nostril is single or undivided, and the incisors exceed three in number in each premaxillary.

Genera *Cynodracon* Ow. Species *C. serridens* Ow., *C. major* Ow.
Cynochampsa Ow. Species *C. laniarius* Ow.
Cynosuchus Ow. Species *C. suppostus* Ow.
Galesaurus Ow. Species *G. planiceps* Ow.
Nythosaurus Ow. Species *N. larvatus* Ow.
Scaloposaurus Ow. Species *S. constrictus* Ow.
Procolophon Ow. Species *P. trigoniceps* Ow., *P. minor* Ow.

Fam. *Tectinarialia.*

Genus *Gorgonops* Ow. Species *G. torvus* Ow.

In 1881 Owen[42] described a new genus, *Ælurosaurus felinus*, from South Africa, which he considered as a member of the *Theriodontia*, belonging to the "Mononarial Section." The animal presents the elevated facial region of the *Pelycosauria*, with the convex alveolar border of the upper jaw and the posterior position of the orbits. The teeth are differentiated as in most all of the South African Reptiles. The posterior portion of the cranium is lost and was later restored by Seeley[43] as an elevated region. There is much more probability that it was depressed by the quick descent of the temporal bones to join the depressed quadrate as in the American forms. Only the skull of the form is known.

In this paper Owen adds certain characters to the order *Theriodontia*. He says: "To the characters of this order given in my *Catalogue of the Fossil Reptilia of South Africa*, viz., 'Dentition of the carnivorous type, incisors laniariform, canine on each side of both upper and lower jaws,' may now be added 'dentition monophyodont.' Add to these characters 'humerus perforated by an entepicondylar foramen.'"

In 1889 Seeley[44] discussed the whole group *Anomodontia* and their relations to the other Permian Reptiles. He says of the *Pelycosauria*, p. 282: "There are few data for judging of the systematic value of the *Pelycosauria*. But in view of the fact that the *Anomodontia* was originally made to include animals which are allied to the *Pelycosauria*, supposing that group to be well founded, it seems more in accordance with usage to class these animals with the *Anomodontia* than to adopt a new name like *Theromorpha* for a well-known ordinal type.

"There is need, however, that the distinctness of the *Pelycosauria* should be established. The tibiale and the centrale are said to unite to form an astragalus which has no movement on the tibia. One face of the astragalus receives the cuboid. Subsequently an entire carpus was figured, which has a very mammalian aspect. It is regarded as referable to *Clepsydrops natalis* Cope, and is classed as *Pelycosauria*. A similar tarsus was subsequently referred with doubt to the genus *Theropleura*. It is difficult to judge of its importance. Its characters appear to be more mammalian than those of the *Crocodilian* tarsus, for the bones of the distal row are completely ossified. The tarsus is absolutely unknown in any of the *Anomodontia* from Africa, Europe and Asia; and, therefore, there is no means of comparison with the American fossil.

"The *Pelycosauria* are said to have two or three sacral vertebræ, a notochordal column and intercentra usually present. With the evidence that *Dinosaurs* may have as few as two sacral vertebræ, as well as a larger number than has been found in any *Ano-*

modont, this ground of ordinal distinction fails. Similarly the mode of ossification of the intervertebral substance presents many types among the *Anomodonts*, one of which, already figured by Sir Richard Owen, might be regarded as notochordal. What the value of the intercentra may be I am unable to say, as they have not been figured; but intercentra, as I understand them, are not unknown among the *Anomodonts*.

"The remarkable vertebral column with the elongated neural spines referred to *Dimetrodon* is apparently unlike any known *Anomodont*, but the elongation of the neural spines in certain of the Wealden reptiles, like (?) *Hylæosaurus*, is not considered to militate against their position in the group to which they belong. And it may be doubted if the more extraordinary neural spine of *Naosaurus*, with its transverse branches, has any greater classificational value, since the transverse branches are the only characters by which the author separates *Naosaurus* from *Dimetrodon*. In *Theropleura*, which is also described as having elevated neural spines, abdominal rods are found. In a further discussion of the subject the author still considers *Empedias* as a member of the *Pelycosauria*."

In a scheme of classification given the *Pelycosauria* are regarded as a doubtful group near to *Lycosaurus* and *Dicynodon*.

In 1895 Seeley[45] divided the *Anomodontia* into three great divisions, the *Therosuchia*, *Therochelonia* and the *Mesosauria* or *Proganosauria*. The *Therosuchia* is defined as follows: "The palatine and the transverse bones of the palate are produced outwards and usually downwards, in an arch, which abuts against the inner side of the mandible. This character defines the group from the *Dicynodonts*, the *Mesosaurs*, *Nothosaurs* and all fossil groups of reptiles. There are more or less completely divided heads to the dorsal ribs. A foramen of variable size occurs between the ischium and the pubis. The ilium extends on both sides of the acetabulum."

The classification here given is as follows:

"*Therosuchia* comprise:

Pareiasauria.
  Procolophonia.
Gorgonopsia.
Dinocephalia.
Deuterosauria.
  Placodontia.
Theriodontia { *Lycosauria.* / *Cynodontia.* / *Gomphodontia.*
Endothiodontia.
Theromora { *Pelycosauria.* / *Cotylosauria.*
Kistecephalia.

"*Therochelonia* comprise :

Dicynodontia.

"*Mesosauria* or *Proganosauria :*

Nothosauria (?)"

In a footnote the author says of the *Theromora :* "This group has no authority at present and is subject to future definition."

Pelycosauria from the Permian of Russia.

In 1838 Kutorga[46] reported the discovery of vertebrate remains on the west slope of the Ural mountains. He considered the remains to belong to mammals and thought that the rocks were of Carboniferous age. Several genera were described, *Brithopus, Orthopus* and *Syodon.*

In 1841 Fischer de Waldheim[47] described from the same locality a new genus, *Rophalodon,* which he characterized as follows : "Gesteilte Zähnen mit hohlen Stielen und mit soliden keulenformiger Krone. R. Wagenheimi, mit vorn gehielten Zähne, der kiel gezähnte. R. Mantelli, mit langsgefurchten Zähne."

In 1842 the same author described a second genus,[48] *Eurosaurus,* from the same material that had been used by Kutorga in his description of *Orthopus.*

In 1845 Wagenheim von Qualen[49] announced in a letter to Fischer the discovery of a specimen in the Russian deposits, which he considered a Carboniferous plant related to *Pecopteris.* This specimen was recognized by Fischer as a skull and described by him[50] in the *Bull. of the Soc. of Moscow* as *Dinosaurus Murchisonii.*

In 1848 Eichwald[51] more fully described the forms *Rhophalodon Wagenheimi* and *Dinosaurus Murchisonii.* The latter genus he regarded as a synonym of the first. Two new genera, *Deuterosaurus* and *Zygosaurus,* were described in the same paper.

In 1857–1858 Herman von Meyer[52] described a few forms from the Permian of Russia and later a second article discussed the same specimens more fully.[53]

In 1860, in his *Lethæ Rossica,* Eichwald[54] described all the known genera from the Russian Permian. He regarded all the Reptilian forms as belonging in two genera only, *Rhophalodon* and *Deuterosaurus.* He gave the following classification :

Fam. *Theriodontisaurier.*

Genus *Deuterosaurus.*

Rhophalodon.

Fam. *Labyrinthodonten.*

Genus *Eurosaurus.*

Zygosaurus.

Archægosaurus.

In 1880 Twelvetrees[55] discovered a skull and humerus in the same deposits from which the earlier Russian fossils had been taken. The skull was of a Labyrinthodont which he called *Platypodosaurus*, and the humerus he referred to Owen's *Theriodontia*.

In the same year the same author described[56] the genus *Cliorhizodon*, and two years later, in an article in the *Geol. Mag.*[57] described teeth referred to the genera *Cynodraco* and *Deuterosarus*.

In 1876 Owen[58] published a review of the Permian reptiles, in which he discussed most of the Permian forms.

In 1883 Trautschold[59] described the remains preserved in the collection of the University of Kasan. Two new genera were described, *Platyops* and *Trematina*.

In 1894 Seeley[60] discussed and figured the two principal genera of the Permian deposits of Russia, *Rhophalodon* and *Deuterosaurus*. He considered that of all the forms described from this region there are only two types. He says, p. 664: "The remains with a *Theriodont* dentition show two generic types, which are indicated by the skulls. They are defined as *Rhophalodon* (Fischer, 1841) and *Deuterosaurus* (Eichwald, 1848). Kutorga had previously founded *Brithopus* on the distal end of a humerus; *Orthopus* on the proximal end of a humerus; *Syodon* was based on a tooth. Fischer in 1847 separated *Dinosaurus* from *Rhophalodon* by dental and cranial characters. It is probable that the separation was based on sufficient evidence. And, although there is no conclusive association of parts of the skeleton to support the reference, it seems to me not improbable that *Brithopus* is identical with *Deuterosaurus*. That *Orthopus* includes *Syodon*, and the type of *Rhophalodon*, while the remainder of *Rhophalodon* corresponds with the genus *Dinosaurus*, as conceived of by Fischer."

These two forms he considers as belonging to the *Anomodontia*, but constituting a separate suborder described as follows, p. 715: "The *Deuterosauria* are defined as *Anomodontia*, distinguished from the other known groups by having (1) the palato-nares divided by the vomer and without having any hard palate extending over them. (2) The canine teeth are serrated (and large) with incisor teeth in front (in *Deuterosaurus*) and molar teeth behind. There are temporal vacuities and a pineal foramen. (3) There is no facet for the head of a rib on the (middle dorsal) vertebræ, and no proof that it was attached between any two centra in any vertebræ; the tubercle is attached to the transverse process. The lower dorsal ribs have no antero-posterior expansion. (4) There are two sacral vertebræ anchylosed. (5) The ilium has a small crest without conspicuous anterior development. The acetabulum is imperforate, as in the *Dicynodontia* and the *Ornithosauria*. The limbs and the shoulder girdle are strong. (6) The scapula is flat.

The two genera appear to be the types of two distinct families, *Deuterosauridæ* and

Rhophalodontidæ, distinguished by the structure of the temporal region of the skull, which has a median crest in the former, and is roofed over on the superior surface in the latter. In the former the incisor teeth are strongly developed; in the latter serrated, lanceolate molars are strongly developed behind the canines.

Deuterosaurus.

Has the skull compressed from side to side, with large transversely compressed incisor teeth. The lachrymal bone is greatly developed. The postorbital arch is deep, and situated below the orbit. The quadrate bone is large and developed below the foramen magnum on the type of *Placodus*. The vertebræ are biconcave. The ribs are long. The sacral ribs are well developed. The scapula is expanded at its free end. The pubis and ischium diverge from below the acetabulum; there is a supra-acetabular, articular wedge on the ilium.

Rhophalodon.

Has the skull more elongate and less deep, with the superior temporal vacuities roofed with bone. The orbit is relatively far back and defended with a circle of sclerotic bones. The incisors are clearly evidenced. The canines are large. The lanceolate molar teeth are of the Megalosaurian type. The vertebræ are biconcave. The scapula is concave on its borders, without conspicuous expansion at the free end. The pubis and ischium do not manifestly diverge ventrally, there may be a supra-acetabular articulation on the ilium."

Pelycosauria from the Permian of Bohemia.

In the first volume of the *Fauna of the Gascoal*, Fritsch[61] described a specimen that he supposed to be a portion of the border of the pectoral fin of a fish. Later in a supplement to the third volume of the same work[62] he recognized the nature of the supposed spine and described it as the neural spine of new species of Cope's genus *Naosaurus*, *N. mirabilis*. This is the only reptile from the Permian deposits of the Bohemian region.

In 1895 Fritsch[63] described new forms from the same horizon. A figure of a dorsal vertebra and spine of the same species as before described is figured. There is no description beyond the statement of the length of the spine. "Dieselben besitzen eine 13fache Länge des Wirbelkörpers und erreichen eine Länge eines *halben Meters*." It is still considered as the single reptile of the horizon.

Description of the Skeleton of Dimetrodon.

The general shape of the skull can best be seen from the figures. There are two temporal arches; an upper, postorbito-squamosal arch, and a lower quadratojugal arch. There is, of course, also a parietoquadrate arch.

Seen from above the following openings are found in the skull: The *anterior nares*, far in front, bounded by the premaxillaries, maxillaries and nasals; the *orbits*, placed nearly vertically, and surrounded by the frontals, prefrontals, lachrymals, jugals, postorbitals and postfrontals; the *supratemporal fossæ*, bounded by the parietal, postorbital, prosquamosal and squamosal; the *infratemporal fossæ*, formed by the postorbital, jugal, quadratojugal and prosquamosal. The *pineal* foramen is placed between the parietals. The *posttemporal fossæ* are surrounded by the posterior parietal processes, the squamosal, the paroccipital processes and the supraoccipital.

The *premaxillaries* (Pl. I, Fig. 1) are small, strong, paired elements. They are suturally united in the middle line, sending a slender process between the nasals. Behind they are united with the maxillaries and at the union a deep notch is present. Their anterior edge is rounded and carried upon a slender recurved process which borders the nasal opening anteriorly and joins the nasals above. The lower portion of the opening is formed by the posterior part of the upper edge of the premaxillary, which is excavated at the base of the superior process. Internally the two bones unite at their anterior edges and show faces for the anterior ends of the vomers. There are three teeth in each premaxillary; the anterior large and strong, followed by two smaller ones. The *nasals* (Pl. I, Fig. 2n) are long and slender bones, connected with the premaxillaries, maxillaries, prefrontals and frontals. They are suturally united in the middle line, and diverging behind to enclose the pointed anterior ends of the frontals, which they overlie. Anteriorly they receive the posterior prolongations of the premaxillaries between them. Below they are united with the maxillaries and behind with the prefrontals. The *frontals* (Pl. I, Fig. 4) are paired. They are of peculiar shape. They form a very short suture with the parietals, reach in front between the posterior ends of the nasals and send out laterally slender processes which take part in the upper border of the orbit. The frontals are flat and narrow, showing that the skull was not very broad. They join the nasals, prefrontals, postfrontals and parietals. The *parietals* (Pl. I, Fig. 5) are very small and short. They are not suturally united with the supraoccipital, but by cartilage. Their posterior processes, which are first horizontal, but vertical at the distal end, join the squamosals. The parietals are connected with the frontals, postfrontals, postorbitals, squamosals, supraoccipital and paroccipital. The *prefrontals* (Pl. I, Fig. 3) are well developed; they take part in the anterior and upper border of the orbit. They join the

frontals, nasals, maxillaries and lachrymals. The whole bone is bent upon itself at a right angle, producing an upper horizontal and lower vertical portion. The posterior

Fig. 1.

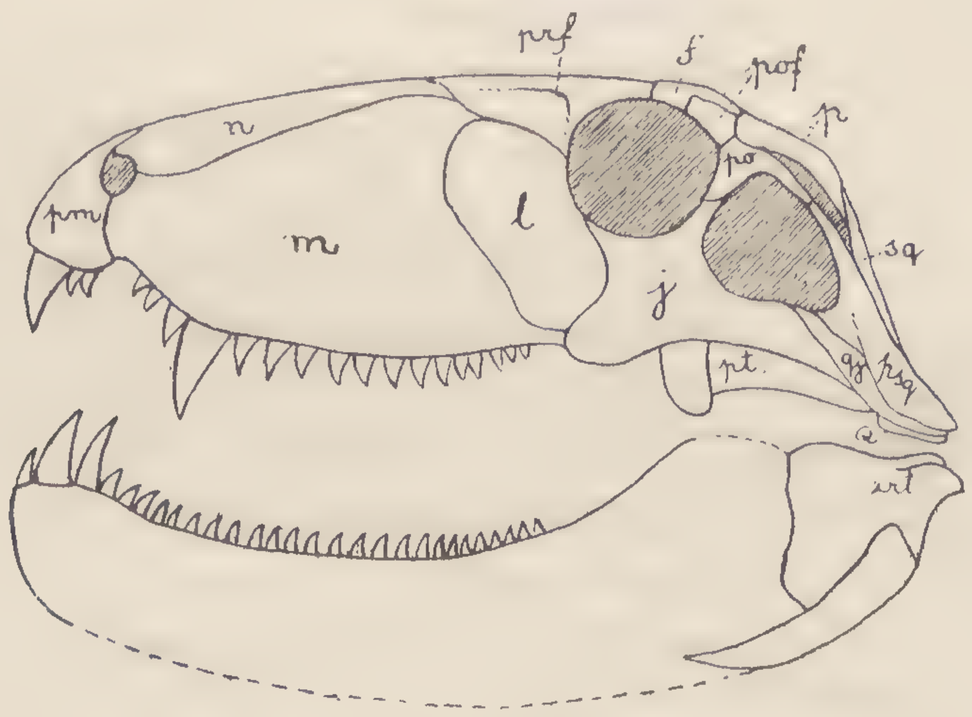


Fig. 2.

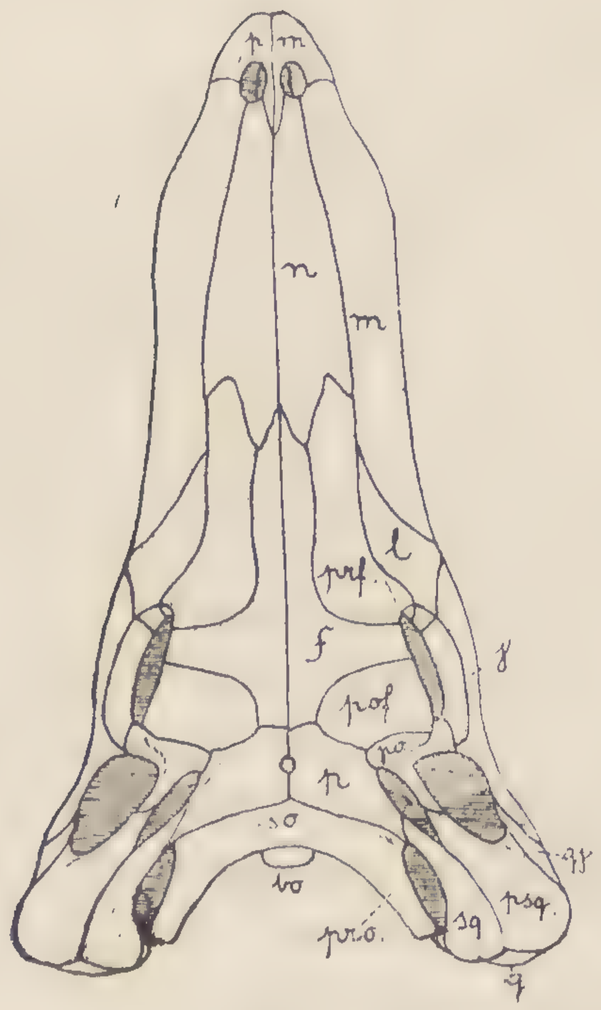


Fig. 3.

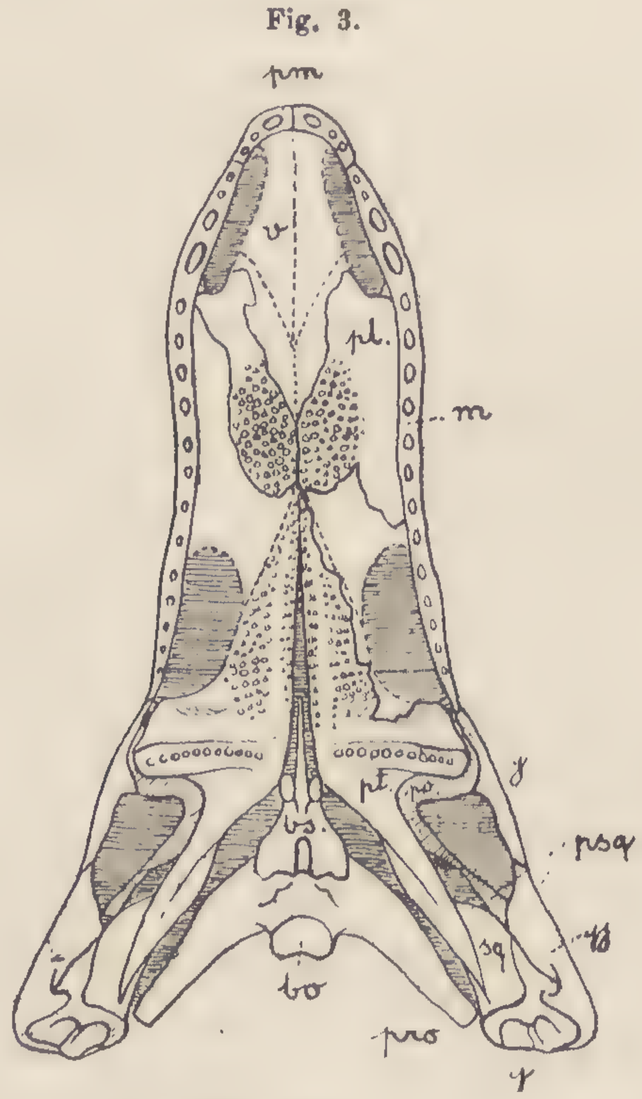


FIG. 1. Skull of Dimetrodon, Cope. Side view.
FIG. 2. Skull of Dimetrodon, Cope. From above.
FIG. 3. Skull of Dimetrodon, Cope. From below.

edge is rounded and thickened, forming the upper anterior border of the orbital rim. Just anterior to this there is a deep excavation, the preorbital pit. The bone becomes

quite thin, but there are no vacuities. The *postfrontals* bound the orbit above and are placed between the frontal, parietal and postorbital. They are approximately quadrangular in outline. Posteriorly they are joined to the postorbital by a broad flaring suture, the ridge thus formed marking the upper posterior angle of the orbital rim. The external edge, which forms part of the orbit, is thickened and rounded. The *postorbitals* (Pl. I, Fig. 7) take part in the formation of the orbit behind. They are united with the postfrontals and parietals above, send a posterior process to the *prosquamosal.* The postorbital is crescentic in outline, thin antero-posteriorly and expanded laterally. The jugal overlies a large part of the posterior surface of the lower portion and receives the lower end into a notch on its inner surface, so that the postorbital takes little part in the rim of the orbit, but forms a large part of its posterior wall. A deep groove extends on the external side between the faces for the postfrontal and jugal and notches the rim. The groove ends internally against a ridge which supports a long posterior process bearing the face for the prosquamosal. Internal to this ridge there is a flat slightly sigmoid face for the parietal.

The *maxillaries* are very large bones, very thin at the upper and lateral parts. They extend as thin plates far up on the side of the skull, reaching the lachrymals, prefrontals and nasals. They form a large part of the inferior and posterior border of the nasal openings. Below they become suddenly very thick to contain the deep alveoli of the teeth. This thickened portion takes the form of a strong ridge on the inner face of the lower edge and extends from the anterior end nearly to the posterior. The lower edge is gently convex downwards, anteriorly it is excavated by a deep notch, which marks the point of union of the maxillary and premaxillary. There are seventeen teeth in the maxillary. Two small ones occupy the maxillary part of the notch ; succeeding this are two large teeth, one just appearing, and finally teeth nearly equal in size, but much smaller than the canine. The canine is directed nearly straight downwards, more convex on the outside than the inner and has well-defined anterior and posterior edges. The succeeding teeth are nearly uniform in size except the last few, which diminish rapidly. They are stout, quite strongly recurved and have strong antero-posterior cutting edges which are finely serrated. The maxillaries are joined with the premaxillary in front, the nasal and prefrontal above, the lachrymal and jugal behind ; at the inner rounded and thickened lower part is found a very distinct suture for the palatines.

Measurements of Maxillary.

	M.
Length (nearly complete)	0.192
Length of largest tooth from base	0.055
Length of largest tooth from outer edge of jaw	0.040
Breadth of the same tooth at base	0.019
Length of fifth tooth from outer edge	0.018

The *lachrymals* are large plate-like and very thin except at their posterior extremity. Here the orbital portion is thickened and pierced by one or two foramina. Below, the edge becomes very thick and strong and is inserted into the posterior edge of the maxillary. The lachrymals form the anterior lower part of the orbit. They are joined to the prefrontals above, the maxillaries in front and below, the jugals behind.

The *jugals* (Pl. I, Fig. 6) are large and take part in the rim of the orbit, forming the lower and part of the posterior edges. The rim is marked by a sharp, elevated ridge. Below it is divided into two main parts. One running forwards and downwards joins the posterior edge of the maxillary. The inner face of this arm is marked by a strong ridge bearing at its lower edge a strong articular face for the ectopterygoid. The second runs almost straight backward, becomes quite slender posteriorly and joins the quadratojugal by a squamous suture. The whole of the lower portion of the bone becomes quite thin. The upper posterior process is united with the postorbital. The jugals join therefore the following elements: In front the lachrymals, below the maxillaries, behind the quadratojugals and above the orbitals.

The *suspensorial region* of the skull is composed of four elements: the *quadrate, quadratojugal, squamosal* and *prosquamosal* (Pl. I, Figs. 8, 9, 10).

The *quadrate* is peculiarly flat and depressed. It is covered superiorly by the squamosal, prosquamosal and quadratojugal. The squamosal, reduced distally to a broad, thin plate, is joined to the upper surface by a squamous suture, covering the inner portion. Laterally it wraps around the inner edge of the quadrate and appears largely on the lower face.

The outer part of the upper surface is covered by the prosquamosal and quadratojugal joining it by squamous suture. The prosquamosal lies just external to the squamosal, but is soon separated from the quadratojugal, which is wedged in between them. Superiorly the quadrate sends a process forward which extends between the squamosal and prosquamosal. The anterior end of this projection is incomplete, but possibly was continued forwards to join the posterior plate of the pterygoid. The outer edge of the projection is marked near its origin by a deep pit extending between the quadrate and quadratojugal. It represents the foramen between the quadrate and quadratojugal in *Sphenodon, Phytosaurus* (*Belodon*) and *Ichthyosaurus.*

The articular face for the lower jaw consists of two grooves lying at a large angle to the main axis of the skull. The outer is the longest and deepest, the inner wide and more shallow. They extend across the inferior face of the bone from before backwards, and are separated by a ridge as high as the external walls.

The *quadratojugal,* as shown by the articular face on the posterior process of the jugal, sent a strong process forwards. Posteriorly the inner edge extends as a wedge

between prosquamosal and the quadrate. On the inferior surface a strong process runs inwards and covers a part of the external edge of the quadrate. This process is notched by the deep pit already described. Anteriorly the bone became very thin and underlay the prosquamosal for quite a distance.

The *squamosal* joins the quadrate as already described. Externally it joins the prosquamosals, the two bones meeting with everted edges to form a narrow ridge. The cranial end of the squamosal was connected with the distal ends of the parietals by a narrow squamous suture.

The *prosquamosal* has been very largely defined in describing the other bones. The superior surface is marked by a prominent ridge, which curves forwards and inwards until it overhangs the ridge formed at the union of the squamosal and prosquamosal. The anterior process became very slender and narrow and joined the posterior prolongation of the postorbital, thus forming the upper temporal arch so characteristic for the *Rhynchocephalia* and the whole group of *Archosauria*.

The bones forming the *cranium* are all preserved, free from distortion and in their natural position. The whole region resembles *Sphenodon* in many particulars, but the obliteration of many of the sutures makes it impossible to compare exactly the separate elements (Pl. I, Figs. 11–14). The *cranium* is formed by the union of the basioccipital, exoccipitals, supraoccipital, the petrosals and the very large paroccipitals. The basisphenoid is completely free from the basioccipital. The connection was, without any doubt, by cartilage.

The *basioccipital* forms the lower half of the occipital condyle. The lower part of the condylar portion is rounded, and the upper comes to a sharp point between the exoccipitals. The point of union between the three bones is marked in some specimens by a deep pit, the anterior prolongation of the chordal canal. The lower surface is converted into a shallow groove by two descending flanges of bone. These meet laterally two other flanges from the paroccipitals, and the suture line is marked by a sharp constriction. Anterior to the trough described the lower surface of the bone rises at an angle of nearly ninety degrees. This face is excavated near its centre by a funnel-like depression, at the base of which lies the foramen for the Eustachian tube, as in the Crocodilia. This region is greatly swollen and contains the *petrosals*, though the sutures are entirely obliterated.

The *exoccipitals* form the borders of the foramen magnum, the basioccipital being excluded by their union below. The superior portions are very slender, and form only a narrow surface around the foramen. Inferiorly they become larger and form the superior half of the occipital condyle. They are pierced near their posterior edge by the condylar foramina.

The *supraoccipital* takes no part in the borders of the foramen magnum, being excluded therefrom by the union of the exoccipitals in the median line above the opening. It is somewhat triangular in outline, with the apex downwards. This is somewhat blunted and rests on the united exoccipitals. The sides join the expanded proximal ends of the paroccipitals. The superior border consists of a broad surface for cartilaginous attachment with the parietals.

The *paroccipitals* are very broad and massive proximally, but are produced in long distal processes. These processes project at a large angle from the posterior region of the skull and pass obliquely backwards, downwards and outwards. The distal articular surface is flat or slightly concave, oval in outline, and probably united to the quadrate by cartilage. The lower surface of these paroccipital processes is marked by two deep pits, separated by a sharp ridge. The proximal portion of the paroccipital is much expanded; above they are in union with the sides of the supraoccipital and bear at the superior edges winglike expansions for the parietals. Below they are suturally united to the exoccipitals and basioccipital. The lower portions of the proximal ends give rise to two descending flanges already described as joining the basioccipital. The region anterior to this flange is deeply excavated and open, so that the foramen rotundum and ovale are freely exposed.

Measurements of the posterior cranial region.

	M.
Distance between distal ends of paroccipitals	0.122
Distance between ends of paroccipital processes	0.112
Breadth of foramen magnum	0.014
Height of foramen magnum	0.009
Breadth of occipital condyle	0.022
Height of occipital condyle	0.016
Distance from top of supraoccipital to lower edge of condyle	0.063

The *basisphenoid* (Pl. I, Figs. 13, 14) is broadly expanded posteriorly and contracts rapidly as it passes forwards, forming a neck just behind the closely approximated faces for the pterygoids, and ends anteriorly in a presphenoidal rostrum. The expanded posterior is marked on its upper edge by a pit, the continuation in the basisphenoid of the Eustachian canal. The centre of the posterior face is prolonged backwards in a spout-like process which lays in the groove described as marking the lower face of the basioccipitals. The lower edge of the expanded part is divided by a deep and long notch which ends abruptly anteriorly.

The basipterygoid processes are near the middle of the basisphenoid. They are short and stout, and in the natural position of the bone were nearly vertical, but directed slightly outwards, downwards and forwards. The upper part of the articular faces is

reflected backwards, forming small facets looking up and out. Between the pterygoid processes a slender presphenoid rostrum rises and projects far forwards. This rostrum is thin laterally, expanded vertically, smooth and straight on the lower edge, roughened above.

The foramina perforating the cranial region and the brain.

The foramina penetrating the bones of the cranium in *Dimetrodon* are remarkably similar in position to those penetrating the same bones in *Sphenodon*. The condylar foramen transmitting the twelfth pair (hypoglossus) penetrates the exoccipital just anterior to the edge of foramen magnum. Its outer end opens in a notch (the *incisura venæ jugularis* Sieb.) in the side of the exoccipital. A little below and further forwards a second and much smaller foramen opens in the same notch; this may transmit either the ninth or tenth pair of nerves or a minor blood vessel. Passing forwards the notch deepens and is very soon converted into a foramen by the adjacent portion of the paroccipital. This is the *foramen venæ jugularis* of Siebenrock,[68] and transmits the jugular vein and either the ninth or tenth nerves or both of them. In *Sphenodon* the foramen transmits not only these but the twelfth pair as well, the nerves being separated from the vein by very thin walls of bone, and may be separated from each other or have a common canal. The opening of the twelfth pair into the notch which forms the beginning of the jugular foramen is then very similar to the condition found in *Sphenodon*.

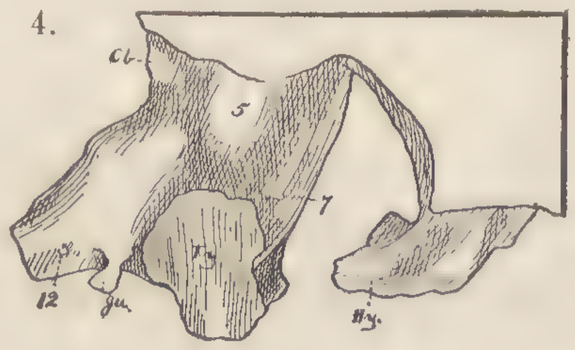
The fenestra ovalis, Fig. 6, *F. O.*, is a single opening leading by a very short canal directly into the brain cavity, a character found in fishes and the amphibian *Menopoma* and existing imperfectly in some recent Reptilia, as the turtles. The same thing is described by Cope as existing in another Permian reptile, from the same horizon as the present specimen, but belonging to a separate family, the *Diadectidæ*, and his order *Cotylosauria*.[69]

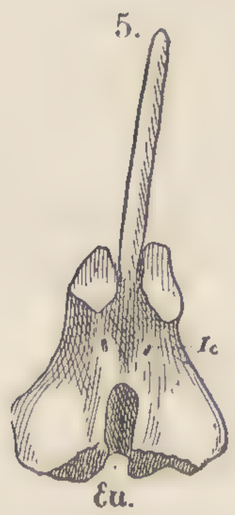
The foramina for the seventh (facial) pair of nerves appear on the outer surface of the petrosal just anterior to the fenestra ovalis (Fig. 6, 7). They are located relatively a little further back than in *Sphenodon*. On the inner face of the same bone the foramina appear at the side of the base of the brain cavity a little anterior to their external opening. They are located just anterior to a slight ridge which defines the limits of the tympanic cavity. In *Sphenodon* this is about the point of location of a foramen common to the seventh and eighth nerves, which, however, almost immediately divides, the posterior branch penetrating the inner wall of the tympanic cavity and leading the auditory nerve to the inner ear.

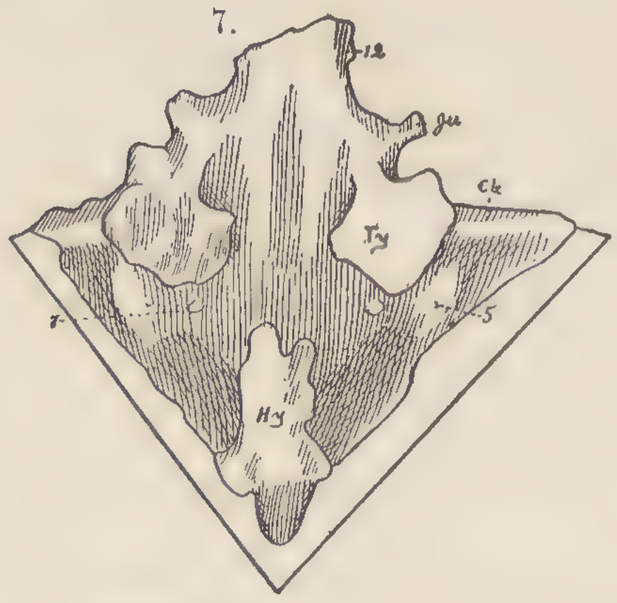
The foramen for the fifth (trigeminus) nerve is completed from the incisura oto-

sphenoidea by the membranous wall of the anterior portion of the brain case, as in *Sphenodon* and many lizards (Fig. 5, 6).

The deep pit excavating the lower surface of the basisphenoid is in all probability the lower opening of the Eustachian tubes. In most reptilian forms the tubes pass into







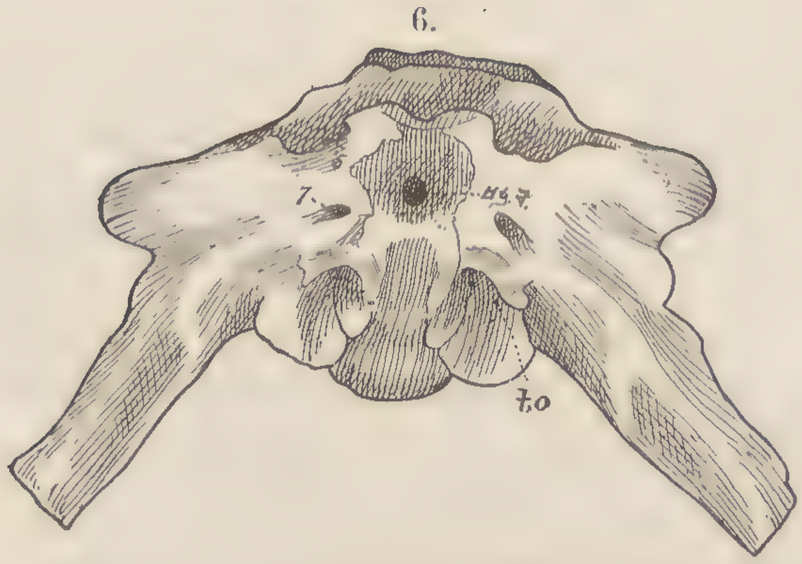


FIG. 4. Side view of a cast of the brain cavity.
FIG. 5. Lower view of the basisphenoid.
FIG. 6. Lower view of the cranial region.
FIG. 7. Lower view of the cast of the brain cavity.

5. The trigeminus nerve. 7. The facial nerve. 12. The hypoglossus nerve. *Ju.* The jugular foramen. *Ty.* Cast of tympanic cavity. *Hy.* Hypophysis. *Hy.F.* Foramen penetrating base of basioccipital. *F.O.* Fenestra ovalis. *I.C.* Foramina for internal carotids. *Eu.* Opening of eustachian tubes. *Cb.* Cerebellum.

the pharynx in the neighborhood of the basioccipital-basisphenoid suture and anterior to the fenestra ovalis. In the Crocodilia and the aglossal batrachians they have a common

opening into the mouth. In the present form the tubes probably penetrated the large mass of cartilage covering the otic region and the posterior end of the basisphenoid and found a common opening in the deep pit described. It is difficult to imagine the use of such an extensive cavity in the basisphenoid, but in the *Teleosauria* an equally large cavity is found roofed over with bone. Anterior to this pit two foramina, Fig. 5, *I. C.*, penetrate the lower surface of the basisphenoid bone and on its upper surface a large foramen appears just posterior to the origin of the presphenoid rostrum. Through the pair on the lower surface the internal carotid arteries enter the bone and through the upper it gains access to the brain cavity by way of the pituatary fossa. On either side of the single foramen a pair of small foramina carry branches of the internal carotid. All of these foramina are very similar in position to the same ones in *Sphenodon.*

The cast of the brain cavity shows fairly well all parts posterior to the fifth pair of nerves, and the hypophysis anterior to them. As is well known, the brain in the Reptilia does not fill the brain cavity, but is supported by a mass of connective tissue carrying lymph and fat masses, so a cast of the brain cavity does not give an exact copy of the brain ; however, many points can be brought out by such a cast.

If the cast be held with the short terminal portion of the medulla horizontal, the lower surface pitches downwards at a sharp angle to a point anterior to the tympanic region and then ascends as sharply to the point of origin of the hypophysis. The superior surface is horizontal and arched from side to side to a point over the tympanic cavity and there turns upwards at an angle of 45°. The angle thus produced is marked by a low, narrow ridge running across the cast and marking the position on the brain of a narrow and elevated cerebellum, Figs. 4 and 7, *Cb.*, such as occurs in *Sphenodon.* This region was probably the seat of a large amount of connective tissue, and it is probable that the upper surface of the medulla descended at as sharp an angle as the lower. This would make still more marked the resemblance to *Sphenodon* and to the cast figured by Cope. This sharp bend of the medulla downwards is not found in other forms, though in the brain of Chelonia and some Lacertilia a bend is apparent.

The sides of the medulla show most posteriorly the beginning of the twelfth nerves, Figs. 4 and 7 (12), anterior to these the cast of the jugular foramen, Figs. 4 and 7, *Ju.*, and finally the large casts of the tympanic cavity, Figs. 4 and 7, *Ty.* The nature of the matrix and the cavities prevented the tympanic cavities being cleaned so that the semicircular canals could be determined, but it is probable that they were very similar to those described by Cope.

Anterior to the tympanic casts a sharp constriction marks the ridge defining the limits of the tympanic cavity and then a sharp outswelling the point of exit of the trigeminus nerve, Figs. 4 and 7 (5). Near where these leave the body of the cast a small stub on each side marks the origin of the seventh pair, Figs. 4 and 7 (7).

The hypophysis is the most interesting feature of the brain. Descending between the anterior inferior process of the petrosal and turning posteriorly, it occupies a small notch in the posterior edge of the upper surface of the basisphenoid and then passes directly into the body of the basioccipital through the foramen mentioned. In the *Crocodilia* a somewhat similar condition exists. The basisphenoid is excavated for a considerable extent to accommodate the hypophysis. This makes it probable that the excavation of the bone is merely a secondary character to make room for the hypophysis, for in the *Crocodilia* the basisphenoid takes a large part in the floor of the brain-cast, and in the present form it is pushed so far downwards that it is excluded and the hypophysis encounters the basioccipital as soon as it turns toward the rear.

Marsh[64, 65] has described in the family *Atlantosauridæ* of his suborder *Sauropoda* of the *Dinosauria* a condition in which the pituatary cavity becomes a canal perforating the basisphenoid and opening into the pharyngeal cavity, considering it an embryonic character such as exists in the chick at the fifth day of incubation.

If the hypophysis occupied the entire cavity in the basioccipital it extended back nearly as far as the tympanic region and much further back than in most reptilian forms. In *Sphenodon*, the *Crocodilia* and some amphibians it reaches well back, but not so far as in the present form.

Compared with *Sphenodon*, the specimen shows the following points of resemblance. The foramina for the blood vessels and nerves are almost identical in position and nature. The contour of the medulla and cerebellum was similar and the hypophysis extended far back. The only point of difference is the excavation of the basioccipital to receive the distal end of the hypophysis. The free communication of the tympanic cavity is a character which is found in many existing primitive forms and is of secondary importance.

The points here brought out confirm the close relationship of *Pelycosauria* to the primitive *Rhyncocephalia* already asserted by Baur and Case.[28]

The Palate.

The following elements of the palatal region are preserved: both the pterygoids (the left nearly complete), the palatine of the left side, lacking the posterior portion and parts of the right one. No traces of the vomers have been found.

The *pterygoids* (Pl. I, Figs. 15, 16) are large bones which show three processes; an anterior horizontal one, becoming very thin in front and underlying the palatines; a posterior one, forming an extensive vertically expanded plate, and an external very massive ectopterygoid portion. The posterior plate leaves the massive part by a roundly trihedral neck; its lower edge runs downwards and backwards to the quadrate. The upper

edge is folded upon itself, forming a long and deep pit on the outer side. The edge is continued backwards horizontally, or even rising a little for nearly half the extent of the plate, and then falls off rapidly to join the inferior edge in a sharp point. The middle of this posterior edge is marked by a notch. It is possible that an anterior prolongation of the quadrate overlapped this part of the pterygoid, as it does in *Sphenodon*.

The massive part stands out from the plate-like portions; supported by a rather stout neck, it expands distally and its external face extended below the line of the teeth and formed an opposing process to the coronoid of the lower jaw. The upper end of the distal portion is injured on both sides, but probably bore a face for the *ectopterygoid*, which must have been present, as there is a distinct face for such a bone on the inner face of the jugal where it meets the maxillary. The ventral edge of the ectopterygoid process is rounded and bears eleven comparatively large teeth, which are placed in distinct alveoles and replaced from behind.

The anterior part is horizontal, the inner edge excepted, which is turned vertically upwards. The inner edges were close together and were united in the anterior part. The lower portion is covered nearly completely with small conical teeth—those on the outer and posterior region are the largest. A groove extends between this tooth-bearing region and a ridge marking the origin of the vertical plate. There are a few small teeth in the groove, and the ridge also bears a series of small teeth.

The pterygoids articulate with the basisphenoid processes just posterior to a point opposite the union of the ectopterygoid processes with the plate-like part. There are no faces on the pterygoid corresponding to those on the basisphenoid processes. The union must have been by ligament. The connection between the posterior processes with the quadrate was also ligamentous.

The *palatines* are strong bones, becoming more slender posteriorly. They are connected with the maxillary by their entire external edge by suture. The articular face is broadened and vertical. The inner portion of the ventral side of the palatines is covered with small conical teeth. The region bordering the posterior nares is preserved and determines their position, their posterior ends being just behind the large canine tooth.

The *vomers* are not preserved, but there are two small faces at the middle portions of the posterior line of the premaxillaries showing where they were attached. They were probably long and slender, paired and covered with small tubercular teeth. That the vomers were directly connected behind with the anterior processes of the pterygoids, excluding the palatines from the middle line, is very probable.

The *lower jaw* is represented by three bones—the *articular*, coössified with the *angular*, the *dentary* and a third bone, probably the *supra-angular*. The *dentary* contains twenty-seven teeth, which are located on a thickened ridge in alveoles. The first tooth is

slender and conical, slightly recurved. The succeeding two are nearly as large as the canine above; the remaining teeth are all small and recurved. The lower edge of the dentary is thin and marked internally with strong suture lines. The symphysis is short.

The Vertebral Column.

The vertebral column is represented by cervicals, dorsals and caudals.

The cervical vertebræ. The following cervicals are preserved: The atlas, with the exception of the neural arches, the axis, the third, the sixth, the seventh and the eighth. Two vertebræ, the fourth and fifth, are missing.

The *atlas* (Pl. II, Fig. 20). The centrum is broad above, antero-posteriorly, but below it is much contracted between the first and second intercentra. The anterior face is divided into an upper and lower part by a compression of the sides opposite the opening of the chordal canal. The lower part is saddle-shaped, and the upper somewhat convex. There are no traces of transverse processes. The posterior face is hidden by the second intercentrum and the axis, but another specimen shows a large opening of the chordal canal, in contrast to a very small one on the anterior face.

The *first intercentrum*, forming the lower piece of the atlas ring, is crescent shaped, with a broad lower rugose surface and a transverse concave keel above. The anterior face of the intercentrum is the largest, concave vertically and transversely, and lodges the lower part of the occipital condyle. The posterior face is convex from above downwards and occupies the saddle-shaped lower half of the anterior face of the atlas. The first intercentrum shows at the distal end below a facet on each side for the articulation of the single-headed atlas ribs.

The *second intercentrum* is similar to the first; the anterior and posterior faces are more equal. It is wedged in between the centra of the atlas and axis, and has the facets for the capitula of the axis ribs placed more to the middle of the posterior edge.

In the *axis* the centrum is well developed; on the ventral side a keel begins to appear. The posterior face of the neural spine is greatly expanded vertically at the base and greatly elevated. The posterior edge of the spine is thickened and divided by a groove which forms a deep cavity between the well-developed zygapophyses below. The apex is marked by a shallow triangular depression. The præzygapophyses are very small, with the articular faces directed downwards. The postzygapophyses are strong and elevated above the centrum. The articular faces look outwards and downwards and meet on the summit of a short keel below. The transverse processes project laterally and ventrally from the anterior part of base of the neural arch. The distal end does not become separated from the body of the neural arch, and is above the neuro-central suture.

The *third cervical* is badly injured by decay, but many points can be made out. The

articular faces are nearly round. The transverse processes curve outwards and downwards as in the axis, but the distal end reaches much further ventrally and is below the neurocentral suture for about a centimeter. The spine rises vertically from the centrum to a height of .147 m. It is broad and stout at the base, but suddenly contracts a short distance above it and ends in a slender rod curved slightly forwards. Between the bases of the præzygapophyses and the spine depressions exist, which become deep elongated pits in the dorsals.

Now follows a gap of two vertebræ. The *sixth* has a cylindrical body and round articular faces. The lower edges of the faces are extended ventrally, forming a slight flange or apron, which becomes very prominent in the posterior dorsals. The middle portion of the anterior edges on each side are reflected, forming an articular face. The transverse processes are short and stout, and stand out directly from the body of the neural arch. The articular face looks outwards and slightly backwards. From the anterior edge of the face a narrow process, bearing an articular face, runs down to the face on the anterior edge of the centrum. This shows that in the cervical region the capitulum and tuberculum of the ribs were still united.

The transverse process stands well above the centrum. There is a deep excavation at its base, running back to the notch between the posterior zygapophyses and the posterior edge of the centrum. This is interrupted near its middle by a ridge running up to the posterior edge of the transverse process. Superiorly the transverse process joins immediately the præzygapophyses, which are interrupted by a deep notch near their base. The articular faces of the postzygapophyses look outwards and downwards and meet on a small keel below. The faces of the præzygapophyses look inwards and upwards, and are slightly cupped.

The spine is thin at the base and somewhat elongate antero-posteriorly, with a thin, prominent ridge running up the anterior and posterior edges. A few centimeters above its origin the spine becomes rounded and then flattened antero-posteriorly. The ridges of the lower part disappear on the rounded part and are replaced by shallow grooves above. The spine has already reached a great height. The part preserved measures .385 m. in height, but this is only one-half of the spine.

The *seventh* and the *eighth cervicals* (Pl. II, Figs. 21, 22) differ only in degree from the sixth, the transverse processes become more slender and the face connecting the tubercular and the capitular faces nearly disappears. The pits above and below the transverse process become deeper and the body of the centrum is more compressed.

The *first* (?) *dorsal* is marked by a total disappearance of the capitular face on the anterior edge of the centrum. The centrum is a little higher and longer than broad. The ends of the chordal canal have broad funnel-like openings with flaring edges; the

canal becomes very small in the middle portion. The descending flange at the lower edge of the articular face has become much deeper than in the cervicals. The distal end of the transverse process has disappeared, but the base shows that it stood well out from the body of the neural arch. The slender process from the tubercular to the capitular face is still present, but incomplete at the proximal end, it still bears a small facet. The pit between the base of the transverse process and the base of the spine has become very long and deep, its anterior end is closed as abruptly as the posterior by the rising of the connection between the anterior end of the base of the transverse process and the præzygapophysis. The excavation below the transverse process is partly filled by a swelling out of the base of the neural spine and is contracted into a pit at a point posterior to the base of the neural spine. At the base of the præzygapophysis, the anterior edge of the centrum supports two small processes, one on each side of the neural canal. These correspond to similar processes on the posterior edge of the preceding centrum. The spine is nearly complete, its shape is the same as described in the cervical region, a plan which persists throughout the whole series of vertebræ. The spine is .872 m. long, or a little over twenty-five times the greatest diameter of the centrum.

The *second dorsal* differs from the first in a slight intensification of the characters.

The *third* and *fourth dorsals* are incomplete and injured by decay. A concavity of the sides of the centrum below the level of the chordal canal renders the keel quite thin and prominent.

The *fifth dorsal* shows a complete transverse process on the right side. The base presents a pinched appearance due to the presence of two deep pits, one above and the other below the base of the process. The anterior edge of the process has become broad and is marked by a deep groove. The tubercular face looks backwards and downwards, it is broad above and sharp below; from this sharp, lower, edge a narrow face runs down and inwards for a short distance, it is the remnant of the face connecting the tubercular and the capitular faces in the cervicals. The anterior and the posterior faces of the centrum are inclined slightly toward each other below and the vertical profile is slightly sigmoid, convex opposite the opening of the chordal canal and concave below it. This leaves quite a space between the lower edges of the opposing vertebræ to accommodate the intercentrum. The flanges descending from the lower edges of the articular faces have become quite broad vertically and the excavation of the lower half of the centrum is deepened so that the keel is thin and prominent. The edge of the keel is concave. The spine is incomplete, but even in its imperfect state over twenty-one times the greatest diameter of the centrum.

The *sixth dorsal* (Pl. II, Figs. 23, 24) shows a very slender base for the transverse

process; the pits above and below it are deep and the supporting ridges are slender. The process stands out nearly straight from the base of the spine.

The *seventh dorsal* closely resembles the sixth. The spine is practically complete; it is over twenty-four times the greatest diameter of the centrum with a length of .830 m.

The *eighth dorsal* shows a marked change in the transverse process which is directed forwards instead of straight outwards or backwards as in the anterior ones of the series. The distal end reaches in front of the anterior end of the centrum. The articular face for the tuberculum looks forwards and downwards, the face which formerly ran to join the capitulum has become a short process extending from one side of the tubercular face. The excavations of the side of the centrum have involved more than one-half of the vertical height, limiting the rounded part to the walls of the chordal canal. The descending flange of the articular face occupies fully one-third of their height and the edges have become very thin. The profile retains the sigmoid outline. To the anterior face of the centrum is attached the slightly displaced intercentrum. It is crescentic in outline and narrow from before backwards. The upper, concave part is divided into two nearly equal faces for the adjoining vertebræ. The lower surface is rugose and the upper posterior edges bear well-defined facets for the capitula of the ribs.

The *ninth dorsal* (Pl. III, Fig. 40) preserves both transverse processes entire. The connecting face between the capitular and the tubercular faces has entirely disappeared on the left side and is very small on the right. The upper edges of the anterior faces of the transverse processes have expanded forwards to join the prezygapophyses and roof over a deep pit below. The spine is nearly perfect. It ends in a slightly expanded rugosity. It is .863 m. long, or twenty-six times the greatest diameter of the centrum.

The *tenth dorsal* (Pl. II, Figs. 25, 26) has a more compressed body, the base of the transverse process is thin and expanded anteroposteriorly. The process curves forwards and reaches well in front of the anterior edge of the centrum. The posterior end of the centrum extends below the anterior end and causes the keel to slant toward the rear.

The *eleventh dorsal* has a very deep and narrow keel. The descending flanges on the faces of the centra take up nearly one-half of the vertical height. The posterior articular face extends below the anterior, giving the same oblique direction to the keel as in the preceding vertebra. An intercentrum belonging either at the posterior or the anterior end of the vertebra shows two well-developed faces for the ribs.

This is the last of the well-preserved dorsals. Posterior to the eleventh are five vertebræ that are badly injured by decay. In all of these the keel is very sharp and is inclined toward the rear. In the next to the last the anterior face is steeply inclined to the rear as it descends. The last two show round articular faces with only a very short

descending flange. Two intercentra preserved are broad and less completely crescentic; they still show large faces for the capitula of the ribs.

There is no trace of vertebræ from the sacral region.

Five *anterior caudals* are preserved (Pl. II, Figs. 27, 28, 29). They have rounded articular faces with broad funnel-like openings of the chordal canal. The præ- and post-zygapophyses are somewhat elevated on the broad neural arches. The ribs are articulated to both the neural arch and the anterior edge of the centrum. The division is not complete into a capitulum and a tuberculum, but a deep groove on the posterior side of the proximal end nearly accomplishes this. They are doubtless free in the most anterior caudals. The ribs are short and slender. Those most anterior are the longest and leave the vertebra by a strong curve upwards. The distal end of each rib well below and in front of the anterior end of the centrum. The keels are low and rounded. The spines are incomplete, but were not, in all probability, so much elevated as in the dorsal series. The three most anterior of the preserved caudals are in the natural position and show that there was a considerable space between the lower edges of the centra. The spaces were filled by flattened intercentra with no facets for rib articulation; they were however attached ligamentously to the capitular head of the rib as this projected free from the edge of the centrum.

Several small vertebræ are preserved from the distal end of the caudal series. They are slender and cylindrical, biconcave and without spines or transverse processes. The gradual reduction of the series shows that the animal must have had a long and slender tail.

The *scapula* (Pl. III, Fig. 30) is falciform in outline. The body is elongate, expanded and quite thin distally. It is so bent upon itself near the proximal end that the main portion lay, in life, more nearly parallel to the vertebral column than perpendicular to it. The lower edge of this portion is concave upwards. The bone is very thin distally, but becomes thickened toward the middle of the shaft, due to the presence of a strong ridge running back from the posterior edge of the humeral face to lose itself on the distal end. A foramen penetrates the shaft just below the beginning of this ridge. The anterior and superior edges are injured by decay and are incomplete. Cope figures the anterior and the superior edges as nearly straight and as meeting at nearly a right angle. He also figures a face for the clavicle near the distal end. The scapula and the coracoid contribute about equally to the deep, obliquely placed cotylus for the humerus. The edges of this cavity are marked by two strong projections, the upper, belonging to the scapular portion of the region, looks forwards and downwards and the lower, the coracoid portion, looks backwards and upwards. The portion of the scapula bearing this face lies at almost a right angle to the rest of the bone.

The *coracoid* (Pl. III, Fig. 30) is small, quadrate in outline, with a thin anterior edge. The lower edge is thickened and deeply notched near its posterior angle. The portion anterior to the notch was considered by Cope as the procoracoid. The posterior edge is concave from behind forwards and becomes swollen in the region of the scapular articulation. The union of the scapula and the coracoid was accomplished only late in life and was probably never perfect.

Measurements.

	M.
Total length of scapula and coracoid	.276
Total length of coracoid	.067
Total breadth of coracoid	.058
Total breadth of distal end of scapula	.103
Greatest extent of humeral face	.069

The *femur* (Pl. III, Figs. 36, 37) is a strong and heavy bone, with well-developed articular surfaces. The proximal end is rounded posteriorly and deeply excavated anteriorly so that it is crescentic in section. There is no distinct head, the whole proximal end being rounded and thickened. There is a strong rugosity near the outer part of the convex posterior surface. The shaft is roundly quadrate in section. The distal end is divided by a deep groove into two strong rugosities, both bearing articular faces. The inner is the shorter and extends inwards at a small angle to the shaft. The articular face is almost entirely on the posterior surface and looks more backwards than downwards. The face is elongated vertically and notched on its inner edge by an extension of the popliteal space. The outer tuberosity is longer than the inner and is directed downwards. It bears two articular faces, one on the posterior surface, looking almost directly backwards, is nearly square in outline, the other is apparently for the head of the fibula; it is largely on the lower surface of the tuberosity and joins the posterior face by a narrow neck near its external side.

Measurements.

	M.
Total length	.220
Breadth of proximal end	.073
Breadth of distal end across condyles	.069
Greatest diameter of shaft at centre	.036

The *humerus* (Pl. III, Fig. 32) is without prominent condyles at the proximal end. The articular face is a wide, concave area lying across the laterally expanded proximal end at nearly a right angle. The inner angle of the proximal end is expanded into a prominent tuberosity. The outer angle is thin, flattened antero-posteriorly and continuous with the strongly developed deltoid ridge. The ridge stands at almost a right angle with the proximal end of the bone. It becomes very prominent with a rugose surface

and ends below by recurving sharply to the shaft. The lower end does not lose itself entirely on the shaft, but remains as a low ridge running down and inwardly to form part of the bridge over the entepicondylar foramen.

The distal end is expanded at nearly a right angle to the proximal end. The ulnar condyle is rounded, smaller than the radial, and somewhat diagonally placed on the outer extremity of the distal end. The face is unequally divided into two facets by a low ridge. There is no deep anconeal pit on the posterior face of the bone. The radial condyle, largely on the anterior face of the bone, is divided into a prominent, rounded external portion and an inner saddle-shaped portion. The inner portion bears no articular face, but is prominent and rugose. The entepicondylar foramen is situated near the upper part of this inner expansion and is enclosed by a strong bridge, the extension of the ridge upon the shaft of the bone. Above the ulnar condyle a deep notch represents the ectepicondylar foramen.

Measurements.

	M.
Total length	.181
Greatest breadth at distal end	.117
Greatest breadth at proximal end	.096
Diameter of shaft at centre	.024
Projection of deltoid ridge	.035

The *ulna* (Pl. III, Figs. 34, 35) is a slender bone, somewhat longer than the humerus, with a flattened shaft. The shaft becomes gradually smaller toward the distal end and then expands slightly again. The proximal end is excavated on its anterior face by a deep fossa looking, in the natural position of the bone, upwards as well as forwards. This cavity is divided by a low ridge into two facets, the larger looking forwards and the smaller and external one looking slightly outwards. This cavity is carried onto the upper face of the bone and divides the inner and outer portions of the proximal end. These extremities are produced above the articular face and form the olecranon process. The outer is the largest and curves inwards, presenting a convex, rugose surface. The distal end of the bone is divided into two distinct articular faces.

Measurements.

	M.
Total length	.202
Greatest breadth at distal end	.037
Greatest breadth at proximal end	.055

The *radius* (Pl. III, Fig. 33) is curved and shorter than the ulna. The shaft is lenticular in section with the edges becoming sharp and prominent toward the distal end. The proximal end is expanded and the articular face for the humerus is deeply concave

and somewhat crescentic in outline. The distal end is less expanded and the single articular face is a shallow pit, oblong in outline.

Measurements.

	M.
Total length	.146
Greatest breadth proximal end	.042
Greatest breadth distal end	.038

The *tibia* (Pl. III, Figs. 38, 39) is greatly enlarged proximally. The shaft is slender and curved and the lower end is only moderately expanded. The cnemial crest is a strong ridge separated from the body of the bone by a deep fossa opening on the outer side. The fossa is continued onto the upper side of the bone as a deep pit which divides the articular face into two unequal halves, connected at their inner ends. These halves are again divided by a low trochlear ridge running fore and aft. On the posterior surface of the bone below the outer or fibular edge of the proximal end there is a strong, rounded swelling. The distal end is semicircular in outline, flattened before and rounded behind. There is no indication of a division of the distal end into articular facets.

Measurements.

	M.
Total length	.177
Breadth upper end from side to side	.072
Breadth upper end from before back	.051
Greatest diameter of shaft at centre	.021
Greatest breadth of distal end	.044

Conclusions.

The description here given of the genus *Dimetrodon*, together with the described characters of the forms mentioned in the historical review, enable a fairly complete characterization of the *Pelycosauria* to be given.

Teeth differentiated into incisors, canines and molars. Generally a diastema between the posterior incisor and the canines. The teeth without lateral cusps, but with the edges frequently serrated. The anterior incisors and the canines of the upper jaw much larger than the other teeth. The diastema in the upper jaw marked by a more or less deep pit at the point of union of the premaxillaries and the maxillaries. The alveolar edge of the upper jaw convex downwards and of the lower jaw concave upwards. The facial region greatly elevated by the expansion of the upper part of the maxillaries and the lachrymals. The region is quite narrow from side to side. The orbits large, round and located far back in the skull. The skull abruptly truncated posteriorly. The posterior aspect

of the skull, formed by a nearly vertical plate, concave from side to side, formed from the union of the exoccipitals, the supraoccipital, the basioccipital and the paroccipitals, the whole bearing a strong resemblance to the same region in *Dicynodon*. The upper and lower temporal arches both present; very short in the antero-posterior direction. The parietal and the superior arch descend rapidly to join the posterior end of the lower arch. The superior temporal vacuity much smaller than the lower. The quadrate greatly depressed and nearly enclosed by the surrounding bones. The lower face of the quadrate marked by two deep parallel grooves which received two corresponding processes on the articular bone of the lower jaw, thus limiting the motion of the lower jaw to the vertical plane. The nares open directly into the mouth at the anterior extremity. The pterygoids, palatines and vomers are covered by many small teeth. The ribs are two-headed in the dorsal region, the capitulum attaching to the intercentrum preceding. The neural spines of the vertebræ elevated or not. Limbs very short and strong. The humerus with an entepicondylar foramen and a notch representing the ectepicondylar foramen. The hind foot possessing both calcaneum and astragalus. A free centrale in the tarsus.

Under the *Pelycosauria*, as here defined, it seems possible to place with a considerable degree of certainty forms from all the regions which have furnished Permian vertebrate fossils. The following are the genera comprising the group as well as can be made out at present:

American forms:

Clepsydrops.
Dimetrodon.
Embolophorous.
Theropleura (doubtfully distinct).
Metarmosaurus (doubtfully distinct).
Archæobolus (doubtfully distinct).
Lysorophus.
Naosaurus.

Bohemian forms:

Naosaurus.

French forms:

Callibrachion.
..... (?)
Stereorachis.

Russian forms:

Deuterosaurus.
Rhophalodon.
Cliorhizodon (?).

South African forms:

Ælurosaurus.
Lycosaurus.
Cynodraco.
Cynosuchus (?).

South African forms:

*Cynodontia.**
Cynognathus.
Galesaurus.
Tigrisuchus.
Cynochampsa.
Nythosaurus.
Scaloposaurus.

There is little doubt that a considerable synonymy exists among the American forms. A majority of the genera were described from characters of the vertebræ alone and were founded on isolated vertebræ or on small series from separate regions of the spinal column. Thus *Lysorhophus* was founded on the fact that the neural arch is separate from the centrum, and that the capitular articulation of the rib is confined to the preceding intercentrum. In *Theropleura* the neural arch was free from the centrum and the capitulum of the rib was attached to the anterior end of the centrum. In *Dimetrodon* the "capitulum extended downwards and forwards to the anterior end of the centrum, but (as far as observed) there is no facet." In *Embolophorous* the capitulum of the rib is definitely described as joining the preceding intercentrum. As has been shown in the description of the skeleton of *Dimetrodon*, all of the conditions of the capitular articulation described in these genera are found in different parts of the column of the single specimen. The freedom or attachment of the neural arch within the group is hardly more than a character of age. *Metarmosaurus* was founded on the shortness of the centrum and the absence of the capitular face, exactly the conditions that are found in the posterior lumbar and the anterior caudals of *Dimetrodon*. There is little doubt that many of these genera are well founded, but only the consideration of a large amount of material will make it possible to clear up the synonymy.

The position of *Theropleura* is doubtful from the fact that the teeth are said to be the largest in the middle of the molar series, a character that is not common in the *Pelycosauria*, and is quite common in the American forms of the *Pareiasauria*. The same thing is true of the Russian form *Deuterosaurus*.

In our preliminary paper [28] the affinities of the *Pelycosauria* were discussed, as follows:

"There cannot be any doubt that *Dimetrodon* is nearest to the *Rhynchocephalia* and *Proganosauria* (*Palæohatteriidæ*). The structure of the skull, the vertebral column, and the humerus are of the same type. The presence of a distinct squamosal and prosquamosal is of special interest. The same condition we find in *Sapheosaurus* H. v. Meyer (*Sauranodon* Jourdan) of the Jurassic *Sapheosauridæ*; and there is very little doubt that these two elements are also present in *Palæohatteria* Credner. The bone marked squa-

*The group *Cynodontia* was considered by Seeley as worthy of separation from the remainder of the forms by the development of lateral tubercles on the teeth. To this character may be added the union of the superior and the inferior temporal arches, and the more or less complete obliteration of the superior temporal foramen. The *Cynodontia* are so close to the other forms of the group that it is impossible to separate them off even as a suborder, but they certainly do demand recognition for the advance in the development of the teeth and of the condition of the cranial arches toward the type of the *Gomphodontia*.

mosal by Credner is the prosquamosal; the true squamosal must have been free, and connected with the parietal processes.

"In *Sphænodon* the maxillary forms the lower boundary of the orbit; in *Palæohatteria* and *Dimetrodon*, the jugal excludes the maxillary from the orbit. The vertebræ with the well-developed intercentra, the ribs with the double articulations, can only be compared with those of the *Rhynchocephalia* and *Proganosauria* (*Palæohatteriidæ*). The presence of a free central bone in the tarsus of the *Pelycosauria* is an original character, which is shared only by the *Palæohatteriidæ* and *Proterosauridæ;* but in the *Palæohatteriidæ* tarsals 4 and 5 are free, in *Proterosaurus* and *Dimetrodon* they are united, to support metatarsal 4 and metatarsal 5. The humerus of *Dimetrodon* can be directly reduced to that of *Sphænodon.* The entepicondylar foramen is well developed in both; the ectepicondylar foramen of *Sphænodon* is represented by a very distinct ectepicondylar groove in *Dimetrodon.*

"The specialization of the *Pelycosauria* consists in the enormous development of the neural spines of the dorsal vertebræ, and in the reduction of the upper part of the quadrate and its nearly complete inclosure by the squamosal, prosquamosal and quadratojugal. It is quite evident, that the *Pelycosauria* with the two temporal arches and the specialized neural spines cannot be the ancestors of Mammals; they represent a specialized side branch of a line leading from the *Proganosauria* to the *Rhynchocephalia*, which becomes extinct in the Permian.

"The Mammals have a single temporal (zygomatic) arch; the posterior nares are placed far behind, and are roofed over by the maxillary and pterygoid plates; the quadrate is completely co-ossified with the squamosal and quadratojugal; the occipital condyle is double, the entepicondylar foramen is present in all the generalized forms. The ancestors of Mammals must show the same condition.

"Seeley [45] has combined a number of Permo-triassic *Reptilia* from South Africa into an order which he calls *Gomphodontia.* These Reptiles are: *Tritylodon* Owen (always so far considered a Mammal), *Diademodon* Seeley, *Gomphognathus* Seeley, *Microgomphodon* Seeley, and *Trirachodon* Seeley.

"In *Gomphognathus* we have a double occipital condyle; the posterior nares are placed far behind and are roofed over by the maxillary and pterygoid plates, and there is an entepicondylar foramen. The quadrate seems to be of the reduced form; a condition we see also in the closely related *Cynognathus.*

"These forms look very much like Mammals and could possibly be ancestral to them. We must suppose that the condition of the palate we see in the *Mammalia* and *Gomphodontia,* has been developed from a type we find among the *Rhynchocephalia.* The *Crocodilia,* where we have a similar palate as in Mammals, show us, how such a type

of palate was developed from the *Rhynchocephalia*, through the Belodonts and the Teleosaurs. It is possible, that the *Gomphodontia* originated from the *Proganosauria*. The question to be solved now is: What is the single temporal arch in the *Gomphodontia* and *Mammalia?* There are two possibilities; it represents either both the upper and lower arches united, or the lower one alone, the upper one being reduced.

"Seeley,[67] in his paper on the *Cynodontia*, gives a lateral view of the skull of *Cynognathus crateronotus*. There is a large supratemporal fossa, but besides, there is a small vacuity, between the squamosal and the jugal. If this vacuity is natural, it can only represent the infratemporal fossa. By the disappearance of this infratemporal fossa a single temporal bar would result. Further researches have to decide this very important question."

In a paper by the junior author [66] an attempt has been made to show that the vacuity here mentioned in the temporal region of *Cynognathus* is not a fracture, but the final stage in the final union of the two arches to form the zygoma of the mammals.

"A specimen of *Cynognathus crateronotus*, figured by Seeley, shows an opening between the upper and lower arches which was uncertain in origin, there being some reason to suppose it to be the result of an injury to the specimen, but a study of the figure of *Procolophon*, given by Seeley, shows the same condition. The enormous quadratojugal (called squamosal by Leydekker) joins the jugal in front, which in turn joins a slender element by its anterior superior corner; this element runs backwards, forming the lower and back portion of the orbit, and is undoubtedly the postorbital. Behind this element is another bone, the squamosal, or squamosal + prosquamosal, which rests upon the quadratojugal below; between all these elements is a small cavity, exactly as in *Cynognathus*. It is hardly probable that a break would occur in the same place in the two specimens, and so they are considered as showing the final stages of the union of the two arches to form the mammalian zygoma."

If these conclusions be correct there is an uninterrupted chain of forms from the most primitive of the *Pelycosauria* with two widely separated arches to the *Gomphodontia* with a single arch made up of the union of the two and in all probability to the Mammals also. With this progress in the development of the zygomatic arch goes a series of changes in other regions of the skull as the gradual assumption of the tuberculate forms of the teeth and the reduction of the quadrate bone.

The *Pelycosauria* now assumes a most important position in the mammalian-reptilian phylum. As stated in the paper last mentioned,[66] the group seems to be the beginning of the long line of forms that culminated in the Mammals.

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Explanation of the Plates.

Plate I—Dimetrodon incisivus Cope.

All figures ½ natural size.

Fig. 1. Premaxillary = pm.
Fig. 2. Nasal and maxillary = n. and m.
Fig. 3. Prefrontal = prf.
Fig. 4. Frontal = f.
Fig. 5. Parietal = p.
Fig. 6. Jugal = j.
Fig. 7. Postorbital = po.

Fig. 8. } Suspensorial region. { Upper view, quadrate = q.; quadratojugal = qj.
Fig. 9. } { Outer view, squamosal = sq.; prosquamosal = psq.
Fig. 10. } { Lower view.

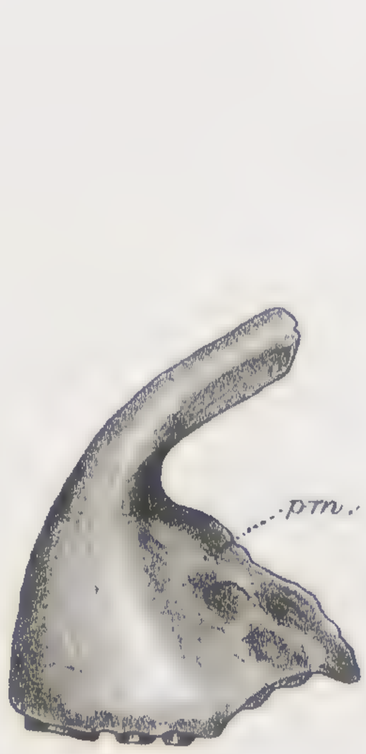
Fig. 11. Cranial region; upper view.
Fig. 12. Cranial region; lower view.
Fig. 13. Basisphenoid; lateral view.
Fig. 14. Basisphenoid; lower view.
Fig. 15. Pterygoid; external view.
Fig. 16. Pterygoid; lower view.
Fig. 17. Dentary = d.
Fig. 18. Articular region; articular = a.; angular portion of articular = an.

Plate II—Dimetrodon incisivus Cope.

Fig. 19. First intercentrum.
a, lower; b, posterior view. ½.
Fig. 20. Centrum of atlas, second intercentrum and axis. ½.
Fig. 21. Seventh cervical; lateral view. ½.
Fig. 22. Seventh cervical; anterior view. ½.
Fig. 23. Sixth dorsal; anterior view. ½.
Fig. 24. Sixth dorsal; lateral view. ½.
Fig. 25. Tenth dorsal; lateral view. ½.
Fig. 26. Tenth dorsal; anterior view. ½.
Fig. 27. Three anterior caudals; lateral view. ½.
Fig. 28. An anterior caudal; anterior view. ½.
Fig. 29. The same; lower view. ½.

Plate III—Dimetrodon incisivus Cope.

Fig. 30. Coracoid and scapula; left side. ½.
Fig. 31. Coracoid and scapula of Sphenodon; left side. 1.
Fig. 32. Humerus, left side; anterior view. ½.
Fig. 33. Radius, left side; anterior view. ½.
Fig. 34. Ulna, left side; anterior view. ½.
Fig. 35. Ulna, left side; lateral view. ½.
Fig. 36. Femur, right side; anterior view. ½.
Fig. 37. Femur, right side; posterior view. ½.
Fig. 38. Tibia, right side; anterior view. ½.
Fig. 39. Tibia, right side; lateral view. ½.
Fig. 40. Ninth dorsal vertebra, complete; posterior view. ⅛.



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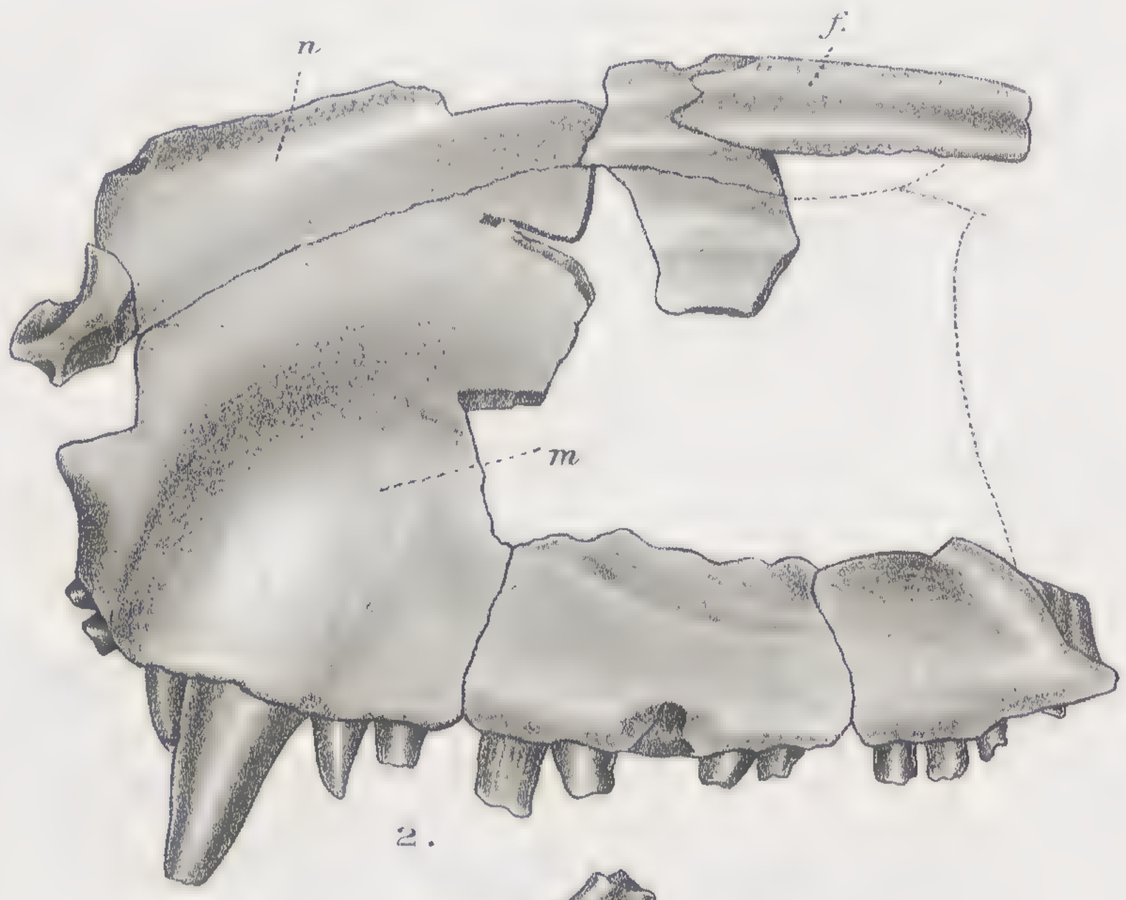

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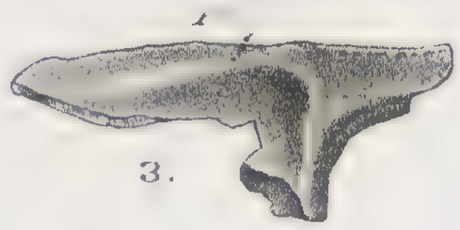

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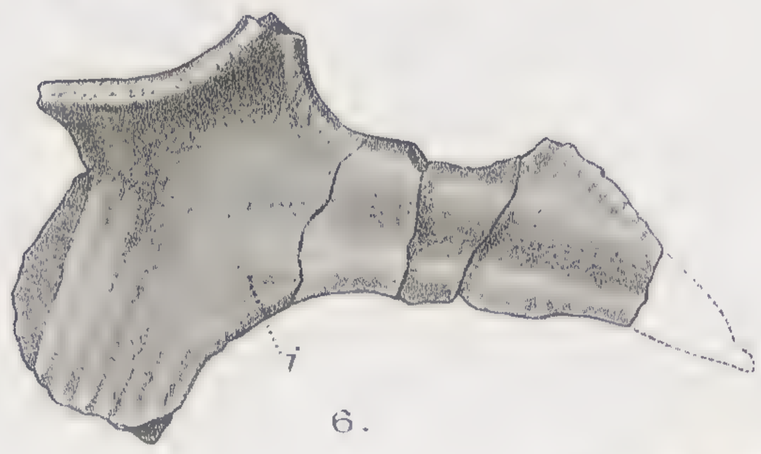

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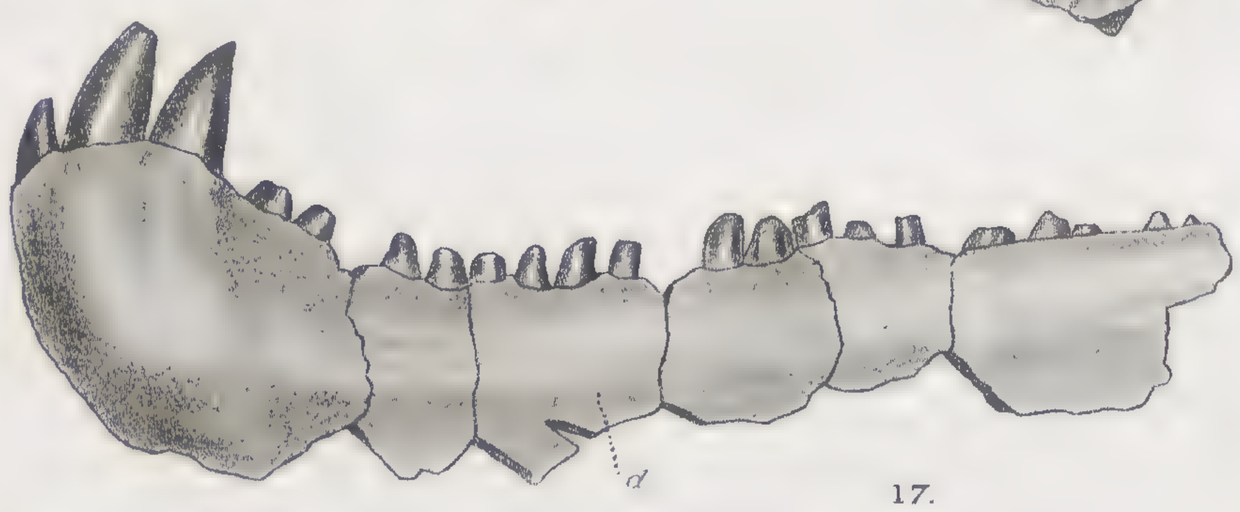

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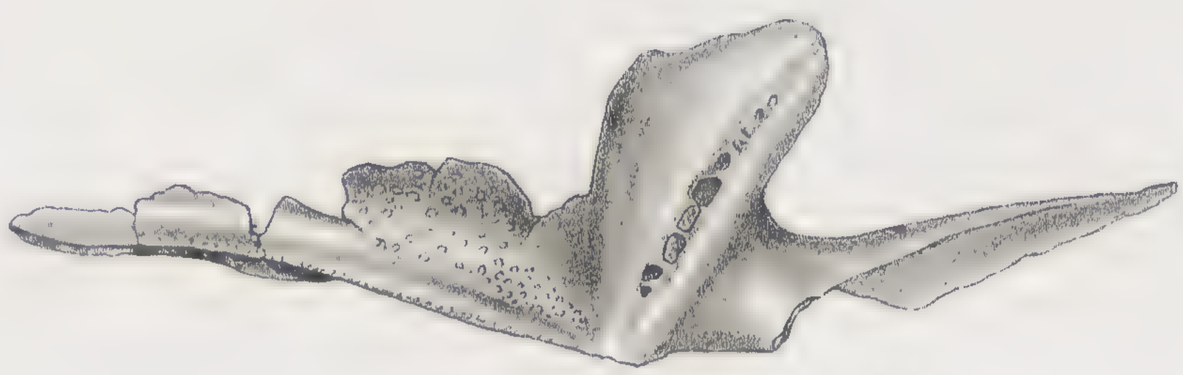
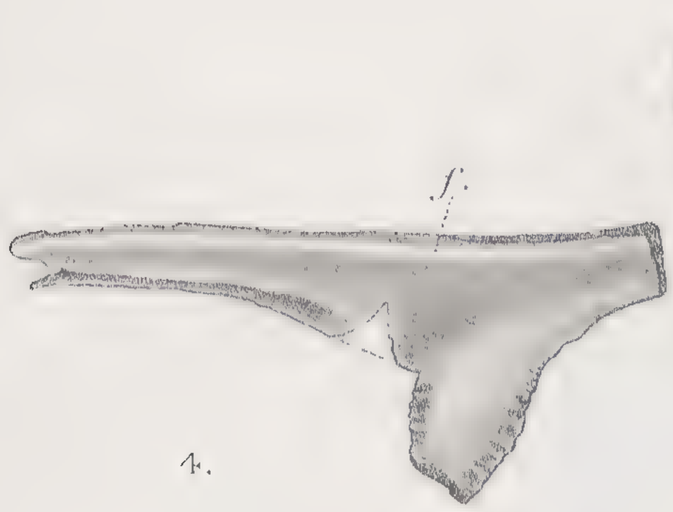


16.

15.

Case del.

1. PREMAXILLARY.
2. NASAL AND MAXILLARY.
3. PREFRONTAL.
6. JUGAL.
16. PTERYGOID, LOWER VIEW.
17. DENTARY.
18. ARTICULAR REGION, = A ; ARTICULAR.



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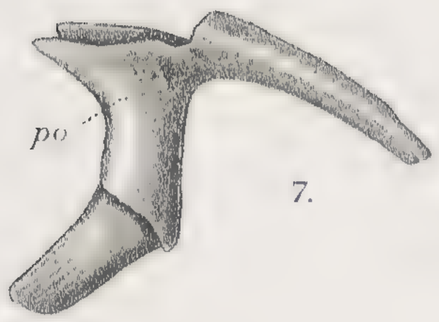

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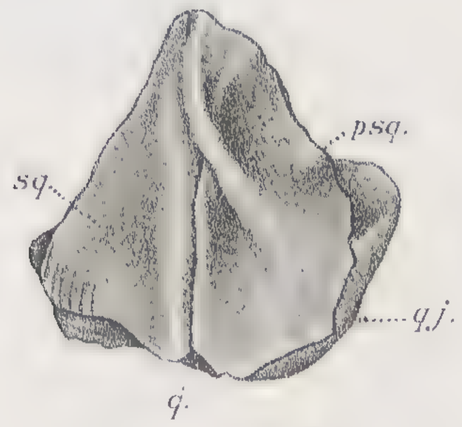

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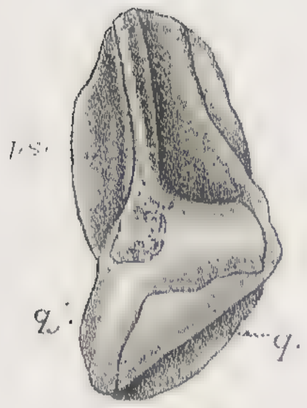

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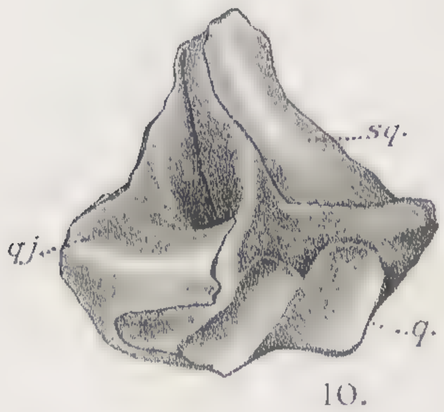

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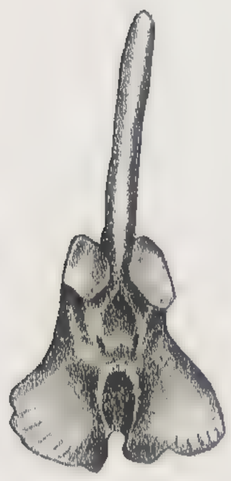

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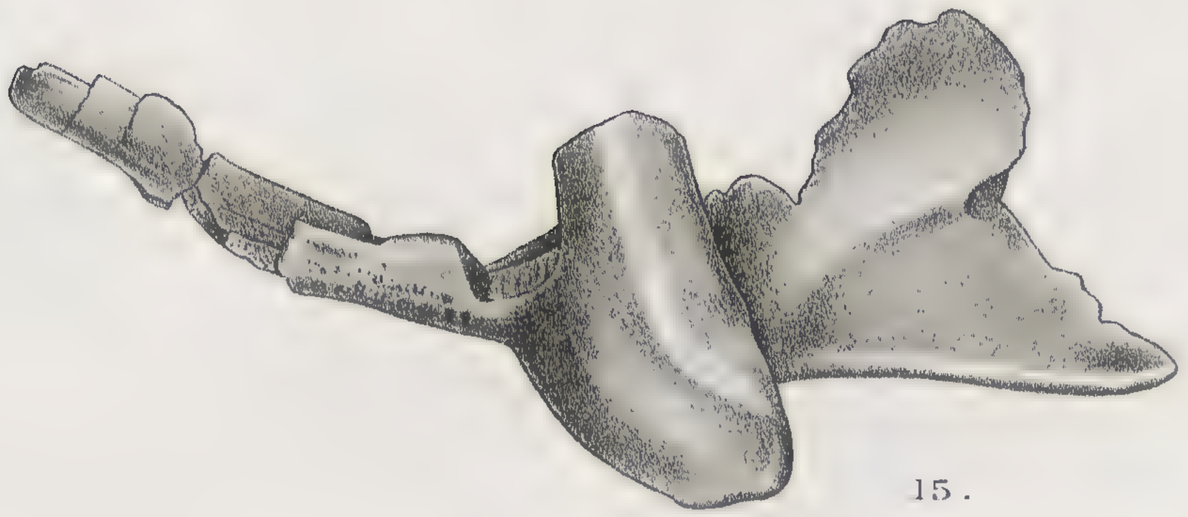
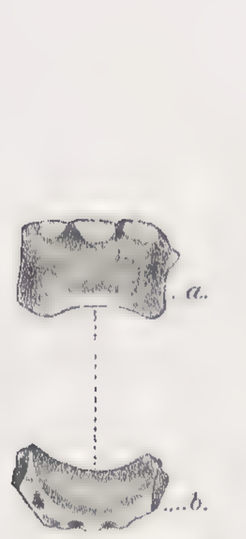


15.

4. FRONTAL.
5. PARIETAL.
7. POSTORBITAL.

8. 9. 10. SUSPENSORIAL REGION — UPPER VIEW, QUADRATE = Q QUADRATE JUGAL = QJ. OUTER VIEW, SQUAMOSAL = S, PROSQUAMOSAL PSQ. LOWER VIEW.

11. CRANIAL REGION, UPPER VIEW.
12. CRANIAL REGION, LOWER VIEW.
14. BASISPHENOID, LOWER VIEW.
15. PTERYGOIND, OUTER VIEW.



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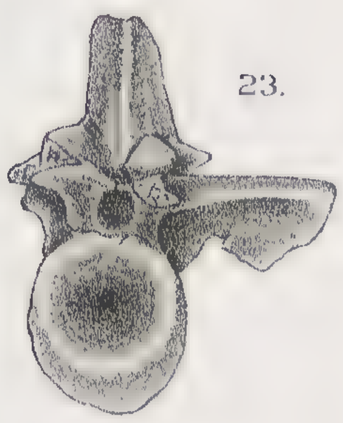

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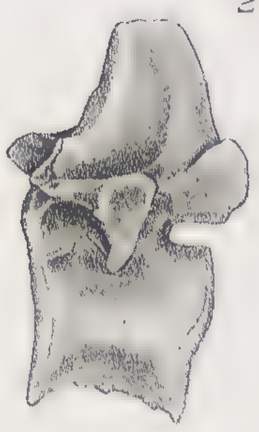

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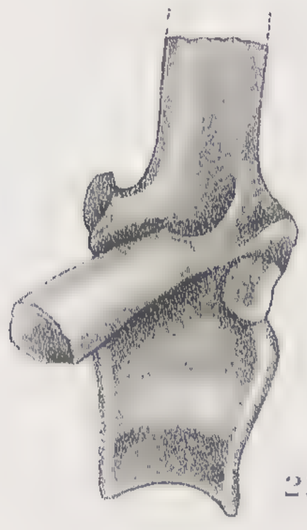

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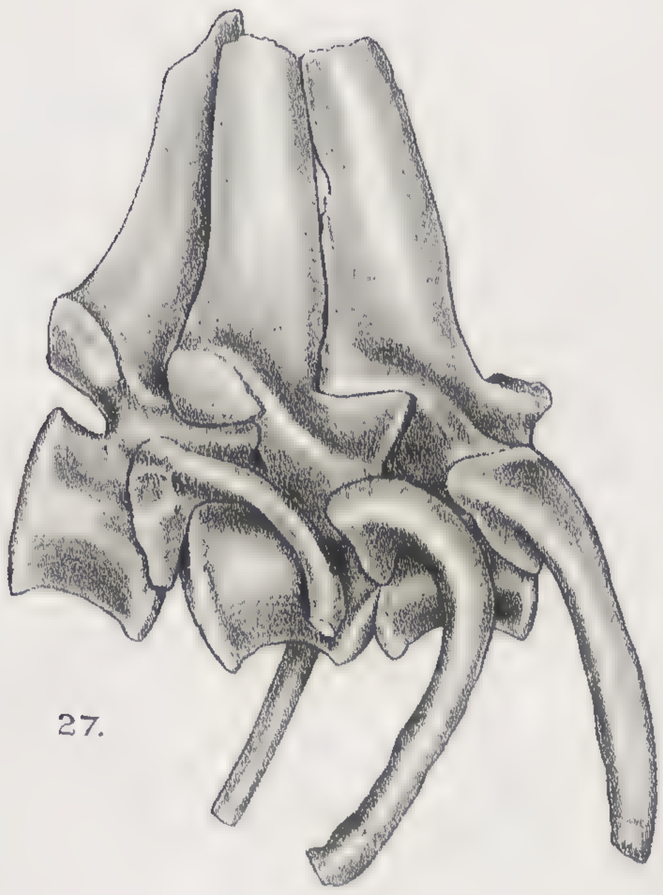

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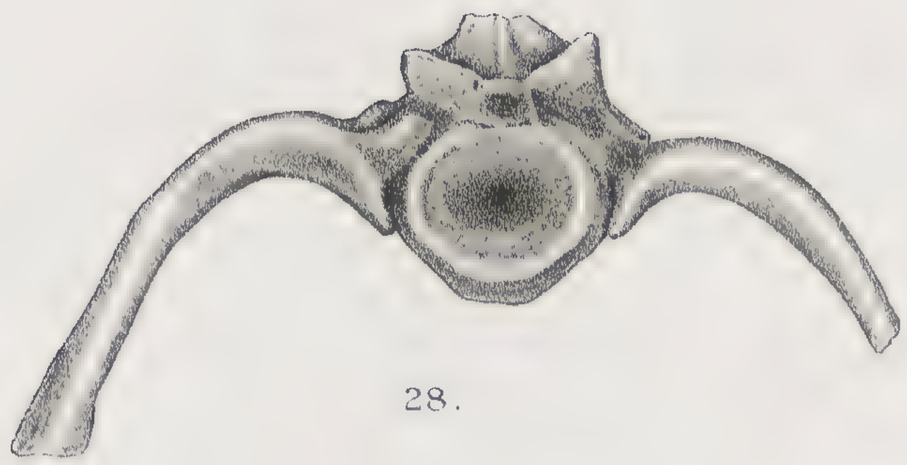

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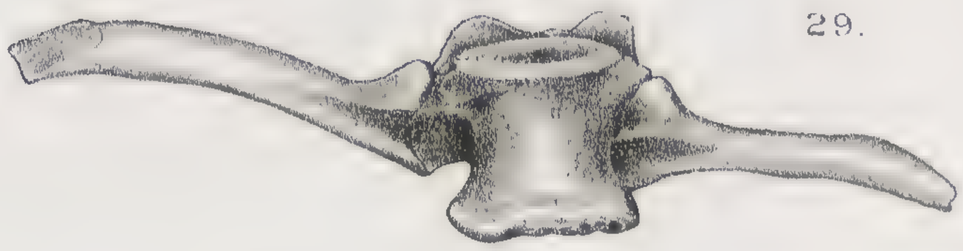

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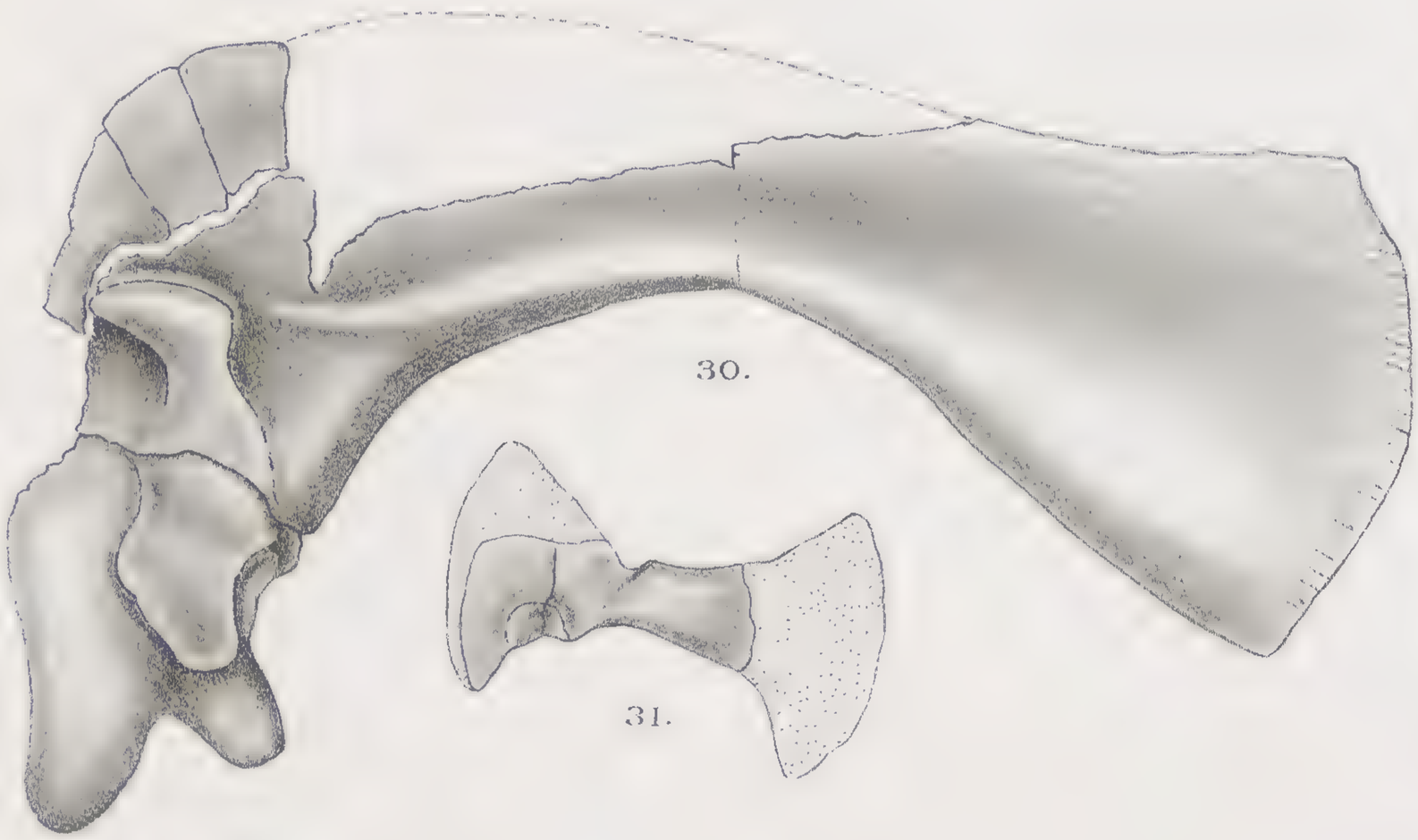
19. FIRST INTERCENTRUM.
20. CENTRUM ATLAS, SECOND INTERCENTRUM AND AXIS.
21. SEVENTH CERVICAL, LATERAL VIEW.
22. SEVENTH CERVICAL, ANTERIOR VIEW.
23. SIXTH DORSAL, ANTERIOR VIEW.
24. SIXTH DORSAL, LATERAL VIEW.
25. TENTH DORSAL, LATERAL VIEW.
26. TENTH DORSAL, ANTERIOR VIEW.
27. THREE ANTERIOR CAUDALS.
28. AN ANTERIOR CAUDAL, ANTERIOR VIEW.
29. THE SAME, LOWER VIEW.



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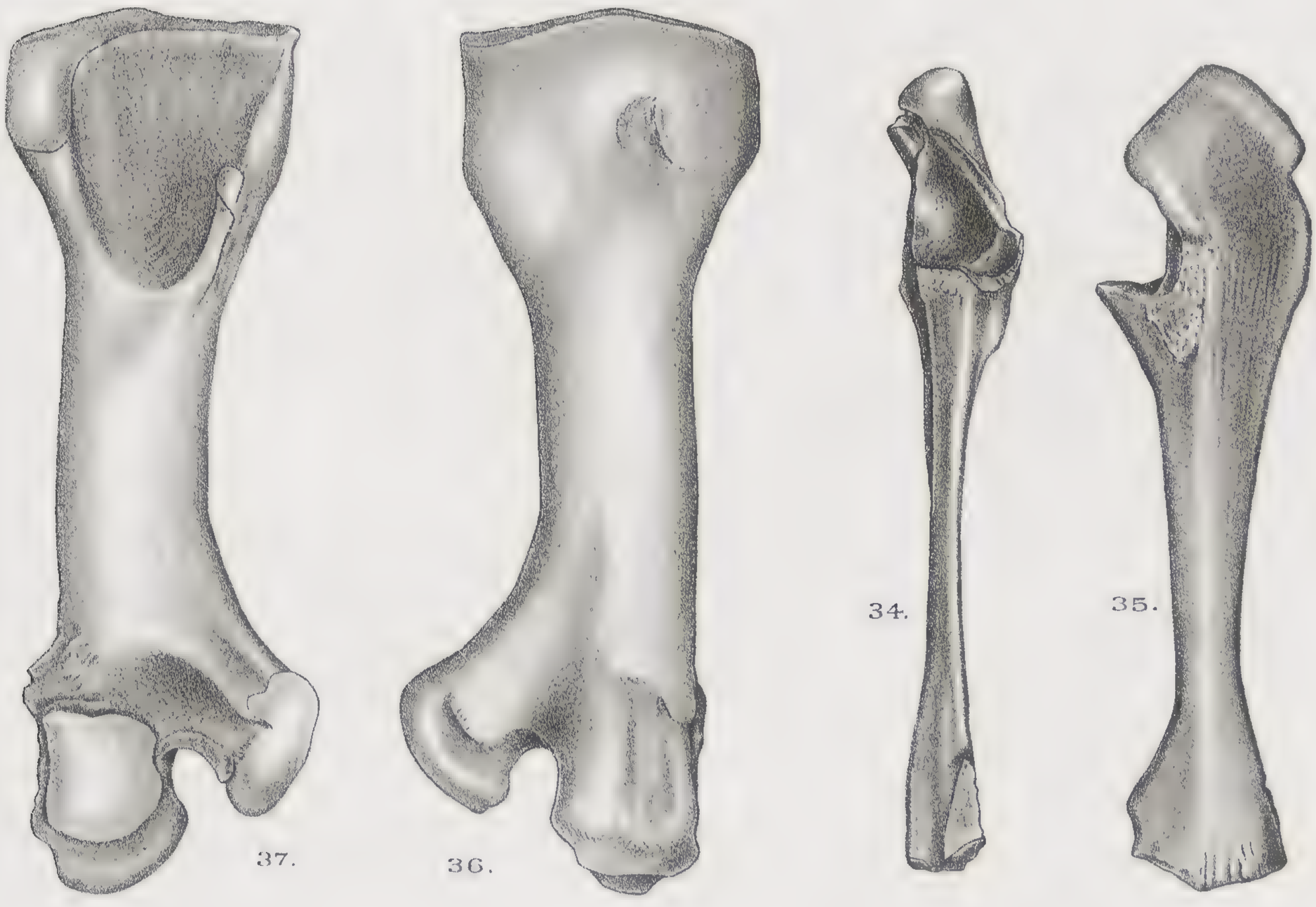
Case del.

30. CORACOID AND SCAPULA, LEFT SIDE.
31. " " " OF SPHENODON, LEFT SIDE.
32. HUMERUS, LEFT SIDE, ANTERIOR VIEW.
33. RADIUS, " " " "
38. TIBIA, RIGHT SIDE, ANTERIOR VIEW.
39. " " " LATERAL VIEW.

40.



34. 35.

37. 36.

34. ULNA, LEFT SIDE, ANTERIOR VIEW.
35. " " " LATERAL VIEW.
36. FEMUR, RIGHT SIDE, ANTERIOR VIEW.
37. " " " POSTERIOR VIEW.
40. NINTH DORSAL VERTEBRA, COMPLETE ; POSTERIOR VIEW.

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PART II.

ARTICLE II.—*The Chronological Distribution of the Elasmobranchs. By O. P. Hay.*

ARTICLE III.—*Results of Observation with the Zenith Telescope of the Sayre Observatory from January 19, 1894, to August 19, 1895. By Charles L. Doolittle.*

ARTICLE IV.—*A Study of the Chromosomes of the Germ Cells of Metazoa. By Thomas H. Montgomery, Jr., Ph.D.*

Philadelphia:
THE AMERICAN PHILOSOPHICAL SOCIETY,
104 S. FIFTH STREET.

1901.

JUL 12 1901

ARTICLE II.

THE CHRONOLOGICAL DISTRIBUTION OF THE ELASMOBRANCHS.

BY O. P. HAY.

Read October 19, 1900.

In *Science*, Vol. x, 1899, p. 683, the writer published a diagram which was designed to represent graphically the chronological distribution of the fossil fishes of North America. Since then it has appeared that a further analysis of the subject is desirable; and this, so far as it pertains to the Elasmobranchii, is here attempted. In the former presentation the Permian period was not separated from that of the Coal-measures; nor were the Mesozoic and Cenozoic ages resolved into their constituent periods. This is here done in a new diagram. Furthermore, the distribution of the fossil Elasmobranchs of Europe is displayed, as well as that of those of North America, the distribution of the former by means of the continuous, that of the latter by the beaded line. From the estimates and statements here given the "ichthyodorulites" have been excluded, although on account of *Onchus* the lines have been made to begin with the Upper Silurian. The numbers accompanying the lines show the number of species known to exist at the times indicated. It may be explained further that the upright lines, and not the spaces, represent the periods of time. For the data appertaining to the European genera and species discussed in this paper, I am indebted especially to Mr. A. S. Woodward's *Catalogue of the Fossil Fishes;* and this work has also furnished me assistance on the American forms.

An examination of the diagram shows that during the Palæozoic era North America possessed a greater number of species than did Europe; while, ever since the Permian period, Europe has considerably surpassed North America. In both North America and Europe the culmination of the class was attained during the Subcarboniferous period; in both there was a rapid decline in genera and species during the time of the Coal-measures. This, as regards America, was shown in the earlier published diagram, but the latter obscured one fact which is here strongly brought out, namely, the

apparently almost complete extinction of the Elasmobranchs during the Permian period. Only about ten species have, so far, been reported from North America, and it is possible that there were even fewer, since the reference of certain deposits in Eastern Illinois to the Permian is perhaps questionable. In Europe about twenty species have been described, the majority of them by Fritsch, within recent years.

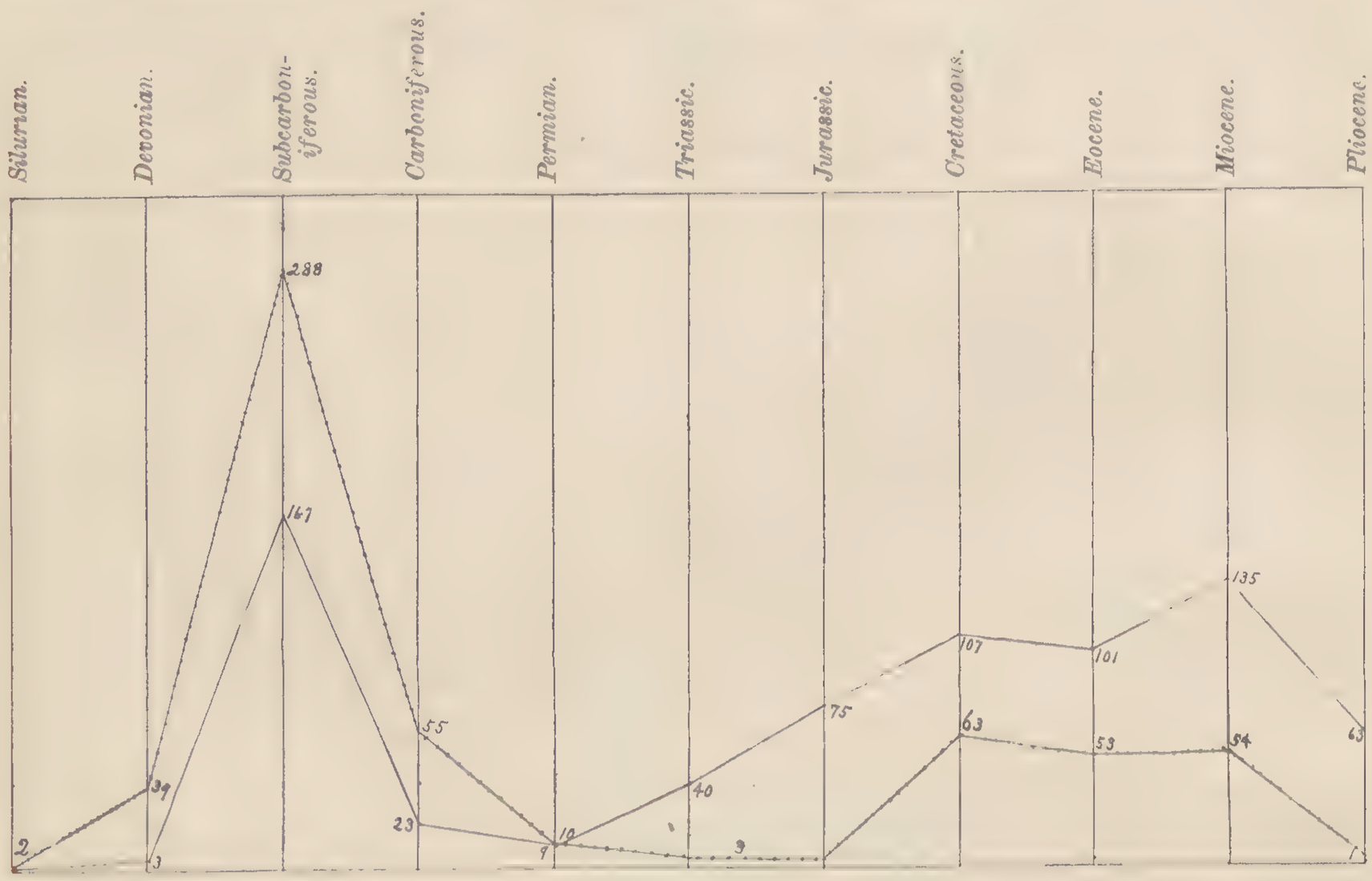

Diagram illustrating distribution of fossil Elasmobranchs.

It is further seen from the diagram that at once after the beginning of the Triassic period the number of species of Elasmobranchs rose rapidly in Europe, while in North America the number apparently even diminished; since only about three species are known to have existed during the time of the laying down of the Jura-Trias. Doubtless this apparent dearth of species is, partly at least, due to the scant development of Triassic and Jurassic rocks in our country.

It might be supposed that in both North America and Europe the conditions during the Permian had been unfavorable for the existence of the genera and species of Elasmobranchs which had flourished in such numbers during the Subcarboniferous; that accordingly they had been driven to some other quarter of the globe; and that it would be found that in some of the Mesozoic periods they had returned to the shores occupied by their Palæozoic ancestors. On this point two things are to be noted: First, we get little or no light on the problem from Permian and early Triassic deposits in other

regions; second, we can hardly expect that the same species would return after the lapse of so long a period. As a matter of fact, no species that existed during the Palæozoic is known from any post-palæozoic formation.

In order to illustrate more clearly the chronological distribution of the Elasmobranchs of the world, I have prepared the accompanying table, which shows the genera that existed during each geological period. As in the case of the diagram, the ichthyodorulites have been excluded; likewise a few unimportant genera, mostly such as existed during only a single period, and most of them belonging to the Subcarboniferous. The genera are arranged under their family names, without reference to their special relationships to one another. The name of every genus which occurs in more than one period is repeated in the proper column. If it is not found in the period following that of its origin, but is found in a still later period, its absence in the intermediate period is indicated by printer's "leaders." All of the genera of the Pliocene column still exist; as do also those there indicated by leaders. Furthermore, two or more genera whose names occur in the same horizontal line have no special relationship to one another; that is, it is not here meant that they stand in the relationship of ancestor and descendant.

In viewing this table we are, first of all perhaps, struck with the blankness of the Triassic column, only four genera there appearing; and these furnished the forty species which existed in the Triassic waters of Europe. The Permian period is somewhat better supplied with genera, although these included only about half as many species as did the three genera of the Triassic. However, the teeth named *Dittodus* quite certainly belong to other genera of Pleuracanthidæ. Hence, we see that not more than from ten to fifteen genera of Elasmobranchs are known to have existed during the Permian period, a meagre number in comparison with the numerous genera of the Subcarboniferous.

Again, examination of the table shows that, with the exception of *Hybodus*, no genus which existed during the Palæozoic era continued on into the post-palæozoic times. The status of *Hybodus* as a Palæozoic genus is open to some doubt and will be considered later. We see, therefore, that whether the Elasmobranchs which had flourished to such an extent during the Subcarboniferous period had remained around the shores of the northern hemisphere during Permian times, but for some reason left only scanty remains; or whether they had been driven to other regions of the globe and returned during post-palæozoic times; when we find them again, if it is their descendants which we find, they have meantime become transformed both specifically and generically.

Table Showing Distribution of the Genera of Fossil Elasmobranchs.

Devonian.	*Subcarbon.*	*Coal-meas.*	*Permian.*	*Triassic.*	*Jurassic.*	*Cretaceous.*	*Eocene.*	*Miocene.*	*Pliocene.*
Pleuracanthidæ									
Dittodus[1]	Dittodus	Dittodus	Dittodus						
Protodus	Pleuracanthus	Pleuracanthus	Pleuracanthus						
Doliodus		Orthacanthus	Orthacanthus						
	Chondrenchelys	Diacranodus	Diacranodus						
	Thrinacodus	Compsacanthus	Xenacanthus						
Cladodontidæ									
Cladodus	Cladodus	Cladodus							
		Symorium							
Phœbodus	Phœbodus	. . . . .	Phœbodus*						
Monocladodus	Hybocladodus	Styptobasis	Styptobasis						
	Lambdodus								
	Carcharopsis[2]								
Cladoselachidæ									
Cladoselache	Cladoselache								
Acanthoëssidæ									
Acanthoëssus[3]	Acanthoëssus	Acanthoëssus	Acanthoëssus						
Cheiracanthus		Acanthodopsis							
Ischnacanthus			Traquaria						
Diplacanthus									
Climatius									
Parexus									
	Petalodontidæ								
	Petalodus	Petalodus							
	Chomatodus	Chomatodus							
	Tanaodus	Tanaodus							
	Polyrhizodus	Polyrhizodus							
	Peltodus	Peltodus							
	Ctenoptychius	Ctenoptychius							
	Callopristodus	Callopristodus							
	Ctenopetalus	Ctenopetalus							
	Janassa	Janassa	Janassa						
	Antliodus	Climaxodus	Thoracodus						
	Petalorhynchus	Cymatodus							
	Fissodus	Calopodus							
	Lisgodus	Lisgodus							
Psammodontidæ									
Psammodus	Psammodus	Psammodus							
	Copodus								
	Archæobatis								
	Cochliodontidæ								
Helodus*	Helodus	Helodus							
	Pleuroplax	Pleuroplax							
	Sandalodus	Sandalodus							
	Platyxystrodus[4]	Platyxystrodus							
	Deltodus	Deltodus							
	Pœcilodus	Pœcilodus							
	Vaticinodus	Vaticinodus							
	Orthopleurodus	Orthopleurodus							
	Cochliodus								
Xenodus[5]									
	Venustodus								
	Deltodopsis								
	Psephodus								
	Streblodus								
	Icanodus[6]								
	Lophodus								

Devonian.	*Subcarbon.*	*Coal-meas.*	*Permian.*	*Triassic.*	*Jurassic.*	*Cretaceous.*	*Eocene.*	*Miocene.*	*Pliocene.*
	Cochliodon- [*tidæ.*								
	Deltoptychius								
	Periplectrodus								
	Stenopterodus								
	Orodontidæ								
	Orodus	Orodus							
	Campodus	Campodus							
	Stemmatias[7]	Stemmatias							
	Petrodus?	Petrodus							
	Sphenacan- [thus	Sphenacan- [thus							
	Mesodmodus	Styracodus							
	Desmiodus								
	Leiodus								
				Heterodontidæ					
				Palæobates	Heterodontus[8]	Heterodontus	Heterodontus	. . . . .	. . . . .
			Hybodus?	Hybodus	Hybodus	Hybodus			
			Wodnika	Acrodus	Acrodus	Acrodus	. . . . .	Acrodus?	
					Asteracanthus	Asteracanthus			
				Parhybodus	Strophodus	Strophodus			
					Palæospinax				
						Synechodus	Synechodus*		
					Orthohybodus				
					Hexanchidæ				
					Hexanchus[9]	Hexanchus	Hexanchus	Hexanchus	Hexanchus
					Lamnidæ				
					Corax	Corax	Corax	Corax?	
					Sphenodus[10]	Carcharias[11]	Carcharias	Carcharias	Carcharias
						Isurus[12]	Isurus	Isurus	Isurus
						Otodus	Otodus	Otodus	
						Lamna	Lamna	Lamna	Lamna
						Carcharodon	Carcharodon	Carcharodon	Carcharodon
						Scapanorhyn- [cus	Alopias	Alopias	. . . . .
							Cetorhinus	Cetorhinus	Cetorhinus
					Scylliorhinidæ				
					Palæoscyllium	Scylliorhinus[13]	Scylliorhinus	Scylliorhinus	Scylliorhinus
					Pristiurus	Mesiteia	Mesiteia		
							Ginglymos- [toma	. . . . .	. . . . .
						Galeidæ			
						Carcharinus[14]	Carcharinus	Carcharinus	Carcharinus
						Galeocerdo	Galeocerdo	Galeocerdo	Galeocerdo
						Hemipristis	Hemipristis	Hemipristis	Hemipristis
						Galeorhinus[15]	Galeorhinus	Galeorhinus	Galeorhinus
							Sphyrna	Sphyrna	Sphyrna
							Protogaleus		
							Pseudogaleus		
						Squalidæ			
						Squalus	. . . . .	Squalus	Squalus
							Scymnorhi- [nus[1]	Seymnorhinus	Scymnorhinus
								Echinorhinus	Echinorhinus
								Centrina	Centrina
									Etmopterus[17]
Tamiobatidæ					*Squatinidæ*				
Tamiobatis					Squatina	Squatina	Squatina	Squatina	Squatina
					Rhinobatidæ				
					Rhinobatus	Rhinobatus	Rhinobatus	Rhinobatus	. . . . .
					Belemnobatis		Trigonorhina	. . . . .	. . . . .
					Asterodermus		Rhynchobatus	. . . . .	. . . . .

Devonian.	*Subcarbon.*	*Coal-meas.*	*Permian.*	*Triassic.*	*Jurassic.*	*Cretaceous.*	*Eocene.*	*Miocene.*	*Pliocene.*
						Rajidæ			
						Raja Cyclobatis	Raja	Raja Acanthobatis	Raja Oncobatis
							Platyrhina	. . . . .	. . . . .
							Narcobatidæ		
							Narcobatus[18]	. . . . .	
							Narcine	. . . . .	
						Pristidæ			
						Sclerorhyn-[chus	Pristis Amblypristis Propristis	Pristis	. . . . .
						Dasyatidæ			
						Dasyatis[19] ?	Dasyatis Urolophus Xyphotrygon	Dasyatis	Dasyatis . . . . .
						.	Tæniura	. . . . .	. . . . .
					Myliobatidæ				
					Myliobatis ?	Myliobatis ? Rhinoptera ? Aëtobatis ? Rhombodus	Myliobatis Rhinoptera Aëtobatis Promyliobatis	Myliobatis Rhinoptera Aëtobatis	Myliobatis Rhinoptera Aëtobatis
						Ptychodon-[*tidæ*			
						Ptychodus Hemiptycho-[dus			
Ptyctodontidæ			Chalcodus ?						
					Squalorajidæ				
Ptyctodus Rhynchodus Palæomylus					Squaloraja				
					Myriacan-[*thidæ*				
					Myriacanthus Chimærops				
					Chimæridæ				
					Ganodus Ischyodus	Edaphodon Ischyodus Elasmodus Leptomylus Elasmodectes Bryactinus Sphagepœa Isotænia	Edaphodon Mylognathus Elasmodus	Edaphodon ? Chimæra ?	Chimæra

[1] Diplodus Ag.; type of Dittodus Owen to be *D. divergens* Owen = *Diplodus gibbosus* Ag.
[2] Dicrenodus Rom.
[3] Acanthodes.
[4] Xystrodus Ag.
[5] Goniodus Newb.
[6] Tomodus Davis.
[7] Stemmatodus St. J. & W.
[8] Cestracion Cuv.
[9] Notidanus Cuv.
[10] Orthacodus A. S. W.
[11] Odontaspis Ag.
[12] Oxyrhina Ag.
[13] Scyllium Cuv.
[14] Carcharias Raf.
[15] Galeus Cuv.
[16] Scymnus Cuv.
[17] Spinax Cuv.
[18] Torpedo Dum.
[19] Trygon Cuv.
* On the authority of Dr. C. R. Eastman.

Furthermore, with the exception of the family Heterodontidæ (Cestraciontidæ), as defined by Mr. Woodward, no family of Elasmobranchs crosses the line dividing the Palæozoic from the post-palæozoic world.

It may be profitable to discuss the fate of the various Palæozoic families of Elasmobranchs, so far as we are able to reach conclusions regarding them from the materials at our command. The Pleuracanthidæ and the Cladodontidæ are so different from all other known sharks that they have been made to constitute a distinct order, the Ichthyotomi. This order represents a distinct offshoot, which extends back as far at least as the Devonian. The Pleuracanthidæ had their maximum of development in species in the Coal-measures; the Cladodontidæ during the Subcarboniferous. In the States lying along the Mississippi river we find the species of the genus *Cladodus* pretty evenly distributed throughout the various divisions of the Subcarboniferous rocks, about thirty-two species occurring therein to seven in the whole thickness of the Coal-measures of the same region. The upper division of the Subcarboniferous, the Chester, alone contained five species. This shows that the genus was a declining one during the period of the Coal-measures. The other genera of the family which existed during the Subcarboniferous period failed to reach the period of the Coal-measures. The structure of the Pleuracanthidæ is quite well understood; that of the Cladodontidæ much less satisfactorily; but from what we do know of the structure and history of the two families, it is very improbable that they were the ancestors of any known sharks of the post-palæozoic world.

The Cladoselachidæ is a small family of a single genus and a very few species. They are, with respect to their paired fins, very generalized; with respect to their tails at least, they are highly specialized. They are not known to pass beyond the early Subcarboniferous;* and no related forms are recognized thereafter.

We have no evidences that the Acanthodii possessed any representatives after the Permian period. The order had its maximum of development in the Devonian. The typical genus, *Acanthoëssus*, continued on into the Permian, in which Fritsch has recently discovered one or two additional genera, containing two species. The members of the order differ so much from other Elasmobranchs that their relationships with the sharks have been doubted. They almost certainly left no post-palæozoic descendants.

Of the numerous genera of the Petalodontidæ the only genus that continued on into the Permian is *Janassa*. Here it is associated with Cope's *Thoracodus*. Hasse has suggested that *Janassa* has relationships with our modern rays; but Jaekel, who has studied this genus, concludes that it had nothing to do with the rays. The Petalodontidæ were, after the time of the Subcarboniferous, a declining group. During this period there

* Dean, B., 1894, *Trans. N. Y. Acad. Sci.*, xiii, p. 115.

were in existence about ninety species; during the Coal-measures, fifteen; during the Permian, only five. Thereafter they are not known.

The Cochliodontidæ formed an extensive family, with a dentition which reminds one strongly of that of the modern *Heterodontus* (Cestracion); but this dentition was, in a way, highly specialized; and it is quite improbable that it later became simplified into the dentition of any post-palæozoic sharks. Moreover, this family too was a decadent one after Subcarboniferous times; since out of more than one hundred and seventy-five species which have been described, only fifteen or fewer belong to the Coal-measures. In the Mississippi valley the family had its culmination in the Keokuk and St. Louis epochs, the middle of the Subcarboniferous. The whole thickness of the deposits of the Coal-measures of the Mississippi valley has furnished only about ten species, about as many as are found in the Kinderhook, a formation about two hundred feet thick. It may be further observed that not a single known genus of this family came into existence during the Coal-measures period.

This review of families brings us to a group of genera which have been included by Mr. A. S. Woodward in the family Cestraciontidæ, or as the writer prefers to call it, Heterodontidæ. This family may, for convenience of discussion, be regarded as consisting of a group of Palæozoic, or more specifically Carboniferous, genera and of a group of post-palæozoic genera. The former group, like most of the families which we have so far considered, had its maximum of development, both as to genera and species, during the Subcarboniferous. Nearly all the genera too had their origin during Subcarboniferous times. Of this group *Orodus* may be taken as the type, being the best known, most abundant in species and most widely distributed. As in the case of the other genera of this group, all we know about *Orodus* is derived from its teeth; and these generally occur isolated. It is admitted by authors that these teeth are not greatly different from those of *Hybodus* of post-palæozoic times. As defined and accepted, however, *Orodus* belongs essentially to the Subcarboniferous period. Of thirty-eight described species only one belongs to the Coal-measures, and this to the lower division. Of nineteen species described from the rocks along the Mississippi river one belongs to the lower Coal-measures, one to the Chester, the uppermost division of the Subcarboniferous; the remainder are nearly equally distributed among the other divisions. In Great Britain the maximum of development of *Orodus* is in the lower portion of the Subcarboniferous. *Campodus* has five species in the Coal-measures, two in the Subcarboniferous. Of the five species of *Sphenacanthus* two belong to the Subcarboniferous, three to the lower Coal-measures. On the whole, the Palæozoic contingent of the Heterodontidæ was a declining one from the time of the Subcarboniferous period.

The other members of Mr. Woodward's Cestraciontidæ are found principally in the

post-palæozoic deposits, and attained the height of their development during the Jurassic; although the two principal genera, *Hybodus* and *Acrodus*, had their maximum in the Triassic. It is not beyond possibility that *Hybodus* occurs in the Permian, a few teeth from that formation having been assigned to the genus. It has indeed been carried back by some palæontologists to the Coal-measures, and into the Subcarboniferous; but this would give to *Hybodus* a term of existence equaled by no other vertebrate genus, and a term quite improbable. Furthermore, no other genus, either Elasmobranchian or of true fishes, is known with certainty to have passed from the Palæozoic to Mesozoic times. If *Hybodus* has done this it holds a unique position. A similar remark may be made regarding the family Heterodontidæ, as limited by Mr. Woodward. If the Carboniferous genera are included in it, the family has come down to our day from the beginning of the Subcarboniferous period; and Rohon describes *Rhabdiodus*, said to be a Hybodontid, from the Upper Silurian. No other family of fishes can claim such a history. We would have to go to the invertebrates to find a family that has existed so long. The assignment of the Palæozoic genera to the family is based wholly on similarities in the teeth; and this character is confessedly unreliable in sharks living in far removed periods of time. Within a few years we have had it announced that in *Chlamydoselache* a living genus of Cladodonts had been discovered; but the error was soon dispelled. Authors differ much in their disposition of the genera here concerned. Dr. Zittel recognizes a family Hybodontidæ in which are put *Hybodus*, *Cladodus* and a number of Subcarboniferous genera; while *Orodus*, *Campodus*, *Acrodus*, etc., are put in the Cestraciontidæ. Jaekel would exclude from the latter family *Orodus*, *Campodus*, etc. Therefore, I do not believe that we shall lose anything by retaining at least the genera of the Carboniferous age in a family with a distinct name, Orodontidæ; and this I have done in the table of genera. Some day a fortunate discovery of some member of the group will reveal its relationships to modern forms. And I believe that I do not err in saying that the discoveries hitherto made of the skeletons of Palæozoic sharks have proved their possessors to have been quite different from modern forms. As proofs of this assertion may be mentioned *Cladodus*, *Cladoselache* and *Pleuracanthus* and its allies.

However, it would be rash to affirm that the post-palæozoic Heterodontidæ have not been derived from some member of the Orodonts. The latter family is apparently the least specialized of the ancient groups, and some one of its less differentiated and more plastic genera may have furnished the progenitors, not only of the Heterodontidæ, but possibly of all the modern families of sharks and rays.

It might be possible, as already suggested, to account for the break in the continuity of the genera and families of Elasmobranchs which occurred during the Permian and earlier Triassic on the ground that the environment along the shores where deposits were

being made was not favorable for their existence; that consequently they migrated elsewhere; and that when they returned, so much time had elapsed that they had necessarily become transformed beyond recognition. We must, however, keep in mind that the Elasmobranchs of the Subcarboniferous period were evidently mostly dwellers in clear open seas, that such seas were probably always accessible to such free-swimming animals, and that the space of time in question has been spanned by more than one family of the higher fishes. The Cœlacanthidæ are known to have survived from the Devonian to the Cretaceous. The Palæoniscidæ likewise began in the Devonian and did not perish until in middle Mesozoic times. During the Subcarboniferous period there existed over forty species. With each succeeding period the number of species became reduced, but the *vis viva* of the family was such that it penetrated into the Jurassic. In the Permian period there existed about thirty known species; in the Trias, fifteen species. None of the genera, however, existed in both Palæozoic and post-palæozoic times.

The Semionotidæ furnish another example of a family which lived through the transition from Palæozoic to later times. It began in the Permian in a feeble way, with a single genus and some five or six species; but the stock possessed such vigor that it was able to endure until in the Cretaceous. In Triassic times there existed a dozen genera and nearly seventy species. The Permian genus *Acentrophorus* is believed to be represented in the Triassic by a single American species; but the identification is in doubt.

It seems probable, therefore, that the failure of the Palæozoic families of Elasmobranchs to perpetuate themselves beyond the Permian period was due more to the organization of the animals themselves than to any specially unfavorable environment. Their vitality seems to have become reduced, and for that reason they perished. This is also indicated by the fact that after the Subcarboniferous period very few new genera were evolved. Among the Palæoniscidæ, on the contrary, new genera were brought into existence with each succeeding period up to near the end of their history. The same is true of the Semionotidæ, although their course was a briefer one. Among the Elasmobranchs themselves, we find that when, after the middle of the Trias, they entered on a new career, the production of new genera went on for a time with energy. Only a few appeared in the Trias, many in the Jurassic, a greater number in the Cretaceous, many in the Eocene. Since then that pristine vigor shown in the organization of new genera has apparently declined; and we may consequently regard the Elasmobranchs of to-day as a moribund race. The seas of the tropical regions are now the homes of the greater number of living forms, and the Tertiary rocks of the tropics have not been thoroughly enough explored to enable us to say how the number of the Miocene species compares with that of the living species; but the Miocene sharks and rays of Europe far outnumber

those now inhabiting European seas. According to Dr. Günther's *Catalogue of the Fishes in the British Museum*, Vol. viii, there are now living only seventy-six European species. During the Miocene there existed one hundred and thirty-five species in that region. In North America the recent species exceed those known from the Miocene in the ratio of eighty-six to fifty-seven; but if only those found along our eastern and southern coasts are compared with the Miocene species of the same region, the numbers are about equal. Doubtless, when our marine Miocene fauna is better known, especially that of our western coast, the number of species will be increased. When all the Miocene species of Europe and America combined are compared with all the living species of the same region, we find the numbers to be approximately 155 and 135. No reason is apparent why these two great regions should not represent well the state of Elasmobranchian development during Miocene times and that of to-day; and even if we leave out of account the insufficiency of the geological record, it shows that, as regards numbers of species, this class has declined.

The remarkable reduction in the number of genera and species of Elasmobranchs during the Permian period finds a parallel in the apparently almost complete extinction of the Brachiopoda at the same time. The facts bearing on this subject have been obtained from Mr. Charles Schuchert's *Synopsis of the Brachiopoda of North America.* The following table shows the number of genera which are known to have existed at each geological age:

Cambrian	28	Triassic	43
Ordovician	66	Jurassic	43
Silurian	75	Cretaceous	31
Devonian	101	Tertiary	20
Carboniferous	76		

This table has the appearance of proving that the Brachiopoda culminated during the Devonian age, thereafter began to decline, and have continued to diminish gradually to the end of the Tertiary; but if we inquire a little more closely into their chronological distribution we shall find that in the Permian deposits there have been found only eight genera and eight species, as Schuchert has shown. Therefore, a curve that would represent the history of the Brachiopoda would resemble closely that representing the history of the Elasmobranchs, except that many phases of the former curve would fall about one age earlier than in the case of the latter.

Concerning the other families of post-palæozoic sharks, I have no remarks to make. The group of rays will be briefly considered. The question of their origin assumes importance from the discovery of *Tamiobatis*, described by Dr. C. R. Eastman.* The

* *Amer. Jour. Sci.*, iv, 1897, p. 85.

specimen on which the genus rests is supposed to have been derived from the Devonian rocks of Kentucky, but may have come from the Subcarboniferous. Dr. Eastman regards this fossil as a true ray; and it certainly possesses many resemblances to one.

Morphologically the rays are not greatly different from the sharks. Dr. Jaekel* holds that the essential character of the rays is found in the attachment of the pectoral fin-supports to the side of the head, all other characters having resulted either from this forward extension and anchorage of the fins to the side of the head or from the mode of life affected by the rays. He doubts, however, the unity of the group which includes the rays, Batoidei of writers. He is inclined to hold that the Dasyatidæ (Trygonidæ) and the Myliobatidæ, the two families forming his "Centrobatidæ" (*Masticura*, Gill, 1872), have sprung from forms like *Ptychodus* and *Strophodus;* and in a recent publication,† the line is traced back to the Psephodontidæ and thence to the Holocephali. The other division of the rays, Jaekel's *Rhinoraji* (*Pachyura*, Gill, 1872), are supposed to have originated from the Spinacidæ (Squalidæ). The two groups are thus removed far apart. I believe, however, that we can say that we have no trustworthy record of the Masticura before the Cretaceous, when at least *Rhombodus* and the Ptychodontidæ lived; nor of the Pachyura before the Jurassic, when *Rhinobatis*, the most primitive of the group, first appears to us.

Now, on the page of this history of the rays, so modern in comparison with the great age of the class Elasmobranchii, we are confronted with the proposition that *Tamiobatis* of the Devonian is a true ray. If the divergence of the Batoidei or either division of them occurred so near the root of the Elasmobranchian stem as the Devonian, they ought to be dignified with the rank of superorder or order, instead of being grudgingly given the rank of suborder, as is done by most writers. We must, then, have very satisfactory evidence before we can admit *Tamiobatis* among the Batoidei. I do not believe that it has been produced. The three characters relied on by Dr. Eastman, in his excellent description, to support his views, are the elongated rostrum, the prominent nasal capsules and the antorbital processes, which are supposed to have served to attach the pectoral fins to the head. Now, the rostrum is one of the most variable organs in presence, form and size, not only among the sharks, but also among the rays. In the shark *Centrophorus* it equals in length the rest of the skull; in the Myliobatid rays it is wholly absent. As regards the antorbital cartilages of *Tamiobatis*, there are, it seems to me, sufficient evidences that they did not support the pectoral fins. In the rays these cartilages are articulated to the nasal capsules, and the distal extremity of each is directed backward along the inner side of the fin. In *Tamiobatis* there is no

* *Die Eocänen Selachier Monte Bolca*, 1894, p. 45.

† *Zeitschr. deutsch. Geolog. Gesellsch.*, li, 1898, p. 298.

indication of any articulation, and the cartilages are directed outward and forward. If it is supposed that there was originally an articulation which has become effaced during fossilization, we must make the unlikely assumption that the two cartilages have been removed from their natural, posteriorly directed position and made to take new positions, symmetrical on the two sides.

The size of the nasal capsules furnishes no certain evidence of the batoid nature of this animal. The hammerhead sharks have these larger than any of the rays; and it is not improbable that *Tamiobatis* had its nasal capsules developed for some such function as is subserved by this organ in the modern hammerheads. *Tamiobatis* must have been quite different in many respects from anything now in existence. Dr. Eastman has figured two structures which he has identified as the postorbital arches. He states that each of these appears to be cut off from the rest of the skull by a small cleft; but he says these clefts have every appearance of being fortuitous. These are alike on the two sides, and to me they appear wholly natural and as the indications of articulations. As Dr. Eastman suggests, the portions thus cut off do not appear to be metapterygoids; and we are left in the dark as to their real nature. It appears to me not improbable that the structures outside the clefts are portions of the palatoquadrate arch, attached to the postorbital process, as it is in some modern sharks. At all events it appears that we are hardly justified in concluding that the fossil in question, which lived in the middle of the Palæozoic era, belongs to a group which, so far as we have any reliable evidence, did not come into existence until the Mesozoic era was well advanced.

ARTICLE III.

RESULTS OF OBSERVATION WITH THE ZENITH TELESCOPE OF THE SAYRE OBSERVATORY FROM JANUARY 19, 1894, TO AUGUST 19, 1895.

BY CHARLES L. DOOLITTLE.

Read October 19, 1900.

Introduction.

The Sayre Observatory, situated at South Bethlehem, Pennsylvania, owes its existence to the liberality of Robert H. Sayre, at whose expense it was erected and equipped in 1868. The object was primarily that of supplying facilities for the instruction of students of the Lehigh University in practical Astronomy. One of the first tasks undertaken by the author of this paper upon taking charge of the department of Astronomy at that institution in 1875 was a very careful determination of the latitude.

The question of possible variations was one of those had in mind at that time. It was then supposed that if anything of this kind took place of sufficient magnitude to be measurable, the changes would be secular in character, and that later determinations might furnish valuable data for deciding the question whether or not such changes existed. This first determination was not finally completed until 1878.

A re-determination was made in 1885–86, which indicated a change of about 0″.4, though the reality of this change was at that time naturally an object of much skepticism.

The work was resumed in 1888, and was continued with some interruptions until the summer of 1895, when my connection with the Lehigh University terminated. The present paper deals with the results obtained from January 19, 1894, to August 19, 1895. Although this is a continuation of work done during previous years, the methods pursued were such as to make this in so far an independent series that it may very properly be presented separately. Moreover, as a re-discussion of the earlier observations and their publication in full constitutes a part of the general plan, they will call for no further consideration here.

The final preparation of this material for publication has been delayed by the circumstance that a preliminary reduction showed it to be very desirable that the star declinations should be determined with a high degree of accuracy and carefully reduced to a

homogeneous system. As but little material for this purpose existed in the case of a considerable number of the stars employed, a complete re-observation of the entire list was kindly undertaken by R. H. Tucker, of the Lick Observatory, and that of individual stars at other places; finally in the spring of 1899 an appropriation by the trustees of the Gould fund provided for the employment of a computer, so that now what for present purposes may be regarded as the final values of the stellar coördinates are available.

In the present series the plan proposed in 1890 by Dr. F. Küstner* was followed. This consists in the employment of four groups of stars, so arranged that they may be connected by evening observations on one group, accompanied by morning observations on the consecutive one. This furnishes the means of adjusting the results to a homogeneous system, and at the same time, as a kind of by-product, a determination of the constant of aberration independently of variations in the latitude.

In the present case the four groups were distributed as follows:

Group	I	5^h31^m	to	7^h23^m	10	pairs.
	II	14 1	to	15 51	10	"
	III	17 30	to	19 35	9	"
	IV	21 29	to	23 52	12	"

The interval between I and II proved to be somewhat too great, for, although these groups were observed during the long nights of January, February and March, the excessive proportion of unfavorable weather at this season made it somewhat difficult to obtain the desired number of satisfactory observations.

The Instrument.

This is a Zenith Telescope by E. & G. W. Blunt, of New York. It is said to have been purchased of the United States Coast Survey in 1868, when the Observatory was first erected. It was then in poor condition, and had probably not been in active service for some time. It was at different times overhauled and repaired, and finally, in 1892, provided by G. Saegmüller, of Washington, with two very fine levels. Though not ranking as a first-class modern instrument, it proved capable, with care and attention in its use, of giving results which are believed to be worthy of entire confidence.

The aperture of the telescope is three inches; focal length, forty-one inches. A diagonal eye-piece was employed, magnifying seventy-five diameters.

The Levels.

The two levels above mentioned were designated A and B. Previous experience with levels had shown that in some cases the scale values did not remain constant. Cases of deterioration had also been met with, good tubes in time becoming worthless.

* *Astronomische Nachrichten*, Bd. 126, No. 3015.

It was therefore determined to examine thoroughly these levels at intervals of three months. As no important changes were found, they afterward received less frequent attention, but the process was always repeated at least twice each year.

In this investigation the ordinary level-trier was employed, consisting of a horizontal bar with a micrometer screw at one end. The proportions in the present case were such that one division of the micrometer head corresponded to an angle of 1″ in the inclination of the bar.

The level tubes were placed in position, carefully protected from disturbances of all kinds and allowed to remain for an hour or two in order to allow the temperature of all parts of the apparatus to come to a condition of equilibrium. The bubble was then brought near one end of the tube and the scale reading noted. The screw was next moved forward two divisions and the scale again read, and so on through something more than the entire part of the scale actually used in observation.

The screw is now moved backward and the reading of the scale noted at the same screw readings as before. From one to two minutes are allowed for the bubble to come to rest after moving the screw. If too much time elapses there is danger that changes of temperature or other disturbing causes may vitiate the result.

The process is illustrated by the following record of the determination of the value of A :

1894, April 1, 10.30 A.M.		Micrometer.	Bubble. N.	Bubble. S.	Mean.	Bubble. N.	Bubble. S.	Mean.	Thermometer, 56°.4.
Backward.	1	71	3.8	26.1	14.95	3.4	25.5	14.45	Forward.
	2	69	4.8	27.1	15.95	4.6	26.7	15.65	
	3	67	6.3	28.6	17.45	6.2	28.3	17.25	
	4	65	8.3	30.6	19.45	7.8	29.9	18.85	
	5	63	9.8	32.1	20.95	9.4	31.5	20.45	
	6	61	11.3	33.6	22.45	10 9	33.1	22.00	
	7	59	13.0	35.3	24.15	12.7	34.9	23.80	
	8	57	14.7	37.0	25.85	14.2	36.4	25.30	
	9	55	16.4	38.6	27.50	15.9	38.1	27.00	
	10	53	18.2	40.5	29.35	17.7	39.9	28.80	
	11	51	19.6	41.8	30.70	19.2	41.4	30.30	
	12	49	21.0	43.2	32.10	20.5	42.8	31.65	
	13	47	22.7	45.0	33.85	22.3	44.5	33.40	
	14	45	24.6	46.8	35.70	23.8	46.1	34.95	
				8—1	10.90			10.85	
				9—2	11.55			11.35	
				10—3	11.90			11.55	
				11—4	11.25			11.45	
				12—5	11.15			11.20	
				13—6	11.40			11.40	
				14—7	11.55			11.15	
				14″ =	11.386			11.279	
			One division	=	1″.229			1″.241	

The same values of the levels were not employed throughout the entire latitude series,

but these values were revised from time to time as new material gave promise of improvement.

The values used were as follows:

1894, January 19–April 26,	A 1″.280	B 1″.028
April 30–September 15,	1″.276	1″.008
October 2–December 6,	1″.292	1″.008
1894, December 23–1895, August 19,	1″.284	1″.024

The Reticle.

This is fitted with three vertical threads and one horizontal. The latter is for the purpose of marking the middle of the field, but it is not required for this. Moreover, it involves the inconvenience that, where the difference of zenith distance is small, one component is found on this thread with surprising frequency, thus interfering seriously with its bisection.

In practice, the stars were bisected at the time of passing each vertical thread. The equatorial intervals of the side threads from the middle one were 13ˢ.46 and 13ˢ.61.

The correction to the latitude for the interval τ is

$$\frac{(15\,\tau)^2}{4}\ \sin 1''\ \tan \delta.$$

This is computed for each pair employed and is practically constant for the entire time embraced by the series.

The Micrometer.

The movable frame carries five threads at intervals of approximately ten revolutions of the screw. There are small pieces of brass near one end of the threads marked with 1, 2, 3, 4 and 5 points respectively, to avoid mistakes in identifying the threads. When the difference of zenith distance is not greater than twenty revolutions, both stars were generally bisected with III; for greater differences II and IV were used to avoid turning the screw through so great a number of revolutions. I and V were not used.

It was necessary to determine carefully the distance between threads II and IV, and as this did not remain constant, the operation must be frequently repeated. After some experimenting, it was found that this could be most satisfactorily done by pointing the telescope toward the sky during daylight and bringing the threads in succession up to the fixed thread before mentioned, moving the screw until the line of light between the two vanished.

In the pages which follow, giving details of the latitude determinations, the column headed δ contains this correction where required, combined with a second correction to the micrometer, the explanation of which will be given presently.

The proper value of the micrometer screw has proved a troublesome question, as it has been found to be a variable quantity. δ Ursae Minoris and 51 Cephei were observed on twenty-three nights during the progress of the work, one star being taken at eastern elongation, preceded or followed, as the case might be, by the other at western elongation. As the altitude of one would be increasing and that of the other diminishing, the mean result should be practically free from errors due to gradual changes of refraction and others of a like character. A preliminary reduction of the latitude observations showed that no one value of the micrometer screw could harmonize the entire series. Evidently the screw had become worn with long service, and the wearing process was still going on at an appreciable rate. A somewhat roughly determined correction for temperature changes removed a part of the difficulty, but not all.

On July 25, 1894, the micrometer was sent to Stackpole & Brother, of New York, for repairs, including a change in the tension of the springs. This naturally produced a change of value at this point, but it was constant neither before nor after. Finally, the conclusion was reached that the screw value must be deduced from the latitude observations themselves and be treated as a variable quantity.

In order to have this method of procedure worthy of confidence, more precise values of the star places were required than those before employed, hence the final reduction was postponed until these became available.

It was observed that the screw was affected by progressive errors of considerable magnitude. An investigation of this matter had formerly been made by employing a measuring engine designed by Prof. William Harkness, of the United States Naval Observatory; but the results had ceased to be applicable, probably a consequence of the wearing of the screw before referred to. The corrections here used were derived from the above-mentioned transits of δ Ursæ Minoris and 51 Cephei.

Let n be any number of revolutions of the screw reckoned from the middle of the scale, the middle in this case being at the twentieth revolution.

Let R be the mean value of one revolution.

If the errors be uniformly progressive, the space S, corresponding to n, will be of the form:

$$S = Rn + \rho\, n^2$$

For a second reading:

$$S' = Rn' + \rho\, n'^2$$
$$S - S' = R\,(n - n') + \rho\,(n^2 - n'^2)$$

The transits of the stars in question were always observed for each revolution of the screw from scale readings 33 to 7. The observed times are first corrected for level changes and for curvature of the stars' path. They are then combined by subtracting

33 from 19, 32 from 18, — — — —, 21 from 7, thus obtaining a series of values of the time required by the star to pass over the space measured by fourteen revolutions of the screw. The difference between any value and the mean of all is the observed correction on account of ρ, expressed in seconds of time. This must finally be converted into its equivalent value in terms of revolutions of the screw.

The means of the differences so found are given in the accompanying table, those for 51 Cephei having been reduced to the equivalent in terms of δ Ursæ Minoris:

	Micrometer.	$n^2 - n'^2$	*Observed Difference.*	*v.*
			s	s
1	19 — 33	— 168	— 3.90	+ .27
2	18 — 32	— 140	— 3.25	+ .22
3	17 — 31	— 112	— 2.55	+ .23
4	16 — 30	— 84	— 2.21	— .13
5	15 — 29	— 56	— 1.48	— .09
6	14 — 28	— 28	— 1.11	— .42
7	13 — 27	0	— .03	— .03
8	12 — 26	+ 28	+ .68	+ .01
9	11 — 25	+ 56	+ 1.47	— .08
10	10 — 24	+ 84	+ 2.26	— .18
11	9 — 23	+ 112	+ 2.97	— .19
12	8 — 22	+ 140	+ 3.35	+ 12
13	7 — 21	+ 168	+ 3.97	+ 20

The "observed difference" above is the observed value of ρ $(n^2 - n'^2)$.

Therefore we have:

$$\rho = + {}^{s}.02483 = .0004354\, R$$

since one revolution R represents the space traversed by the star in $57^{s}.02$.

With this value of ρ we compute the corrections to the micrometer readings which follow. These are expressed in terms of one revolution of the screw:

Micrometer.	*Correction.*	*Micrometer.*	*Correction.*
7 & 33	+ .0736	14 & 26	+ .0157
8 32	.0627	15 25	.0109
9 31	.0527	16 24	.0070
10 30	.0435	17 23	.0039
11 29	.0353	18 22	.0017
12 28	.0279	19 21	.0004
13 27	.0213	20	.0000

These corrections are applied to the micrometer readings and a preliminary reduction carried out employing an approximate value of the screw, as follows:

From 1894, Jan. 19 to July 25,	$R =$	50″.5352
July 25 to Dec. 6,		50.5646
Dec. 6 to end of series,		50.5735

We can now write for each observed latitude an equation of the form

$$\sqrt{\rho}\,(\Delta\phi - (M - M')\,\Delta\tfrac{1}{2}R = n),$$

where $\Delta\phi$ and ΔR are corrections to the latitude and the assumed screw value, M and M' being the micrometer readings, corrected, of course, for progressive errors.

Fourteen sets of equations were formed for deriving corresponding values of $\Delta\phi$ and $\Delta\frac{1}{2}R$, the aim being to limit each series in respect to time, so that no considerable changes in those quantities need be apprehended.

The following example will illustrate the process:

Group.	*Number.*	*No. of Obs.*	$\sqrt{\rho}$	$M - M'$.	n.	v.
I	1	10	1	— 15.3	— .49	— 06
	2	10	1	+ 4.2	+ .40	— 20
	3	9	1	— 14.2	— .57	+ 06
	4	11	1	— 3.5	— 37	+ 27
	5	11	1	+ 8.3	+ .32	+ 04
	6	10	1	+ 6.7	+ .30	— 01
	7	10	1	— 16.1	— .88	+ 30
	8	10	1	+ 6.4	+ .42	— 14
	9	10	1	— 5.3	— .01	— 16
	10	9	1	+ 21.4	+ .88	— 02
II	11	5	0.7	— 6.4	— .18	— 03
	12	5	0.7	— 5.1	— .23	+ 07
	13	4	0.7	+ 2.5	+ .56	— 43
	14	3	0.6	— 2.1	— .08	+ 03
	15	3	0.6	— 0.3	— .03	+ 05
	16	3	0.6	— 22.9	— .54	— 31
	17	3	0.6	— 11.7	— .35	— 06
	18	3	0.6	+ 20.9	+ .24	+ 60
	19	2	0.5	+ 16.0	+ .64	+ 01

From these equations,

$$\Delta\phi = + .0354$$
$$\Delta\tfrac{1}{2}R = + .0385$$

No use is made of $\Delta\phi$ in what follows.

All observations on one pair during the time embraced have been combined into one equation, the number being indicated in the third column.

The following table gives the results derived from these fourteen sets of equations. The adjusted value of $\Delta\frac{1}{2}R$ is explained in what follows:

	Date.	Mean Temperature.	Assumed ½R.	Computed Δ½R.	√wt.	Adjusted Δ½R.	v.
1	1894. Jan. 19–Feb. 16	23°.3	25.2676	+ .0385	1.	+ .0395	+ 10
2	Feb. 19–Mar. 18	35.2		+ 0382	1.0	+ .0369	— 13
3	Mar. 19–Apr. 30	47.3		+ 0351	0.7	+ .0342	— 9
4	May 8–June 11	60.7		+ 0317	1.0	+ .0313	— 4
5	June 12–July 5	72.4		+ 0263	1.0	+ 0287	+ 24
6	July 9–July 25	70.8		+ 0302	1.0	+ 0290	— 12
7	Aug. 5–Sept. 15	66.2	25.2823	— 0176	1.0	— 0100	+ 76
8	Oct. 2–Nov. 12	47.0		— 0083	1.0	— 0057	+ 26
9	Nov. 15–Dec. 6	35.5		— 0077	1.0	— 0032	+ 45
10	Dec. 25–Jan. 24	21.5	25.28675	— 0020	0.7	— 0045.5	— 25
11	1895. Jan. 27–Mar. 28	28.9		— 0040	1.0	— 0061 5	— 22
12	Apr. 10–Mar. 6	47.3		— 0065	0.7	— 0102.5	— 37
13	May 9–June 29	62.0		— 0123	1.0	— 0134.5	— 11
14	July 9–Aug. 19	67.6		— 0064	1.0	— 0147.5	— 83

A graphic construction showed that the values of $\frac{1}{2}R$ might be approximately represented by the expressions—

$$25''.2939 + x + (t - 21°.5)\ z \text{ before July 25, 1894.}$$
$$25''.2647 + y + (t - 21°.5)\ z \text{ after July 25, 1894.}$$

Solving the resulting equations for x, y and z, these expressions become—

$$25''.3075 - 2.21\ (t - 21°.5).$$
$$25''.2647 - 2.21\ (t - 21°.5).$$

t being the mean temperature and the coefficient 2.21 expressed in units of the fourth decimal place of the screw value.

From these expressions result the adjusted values given in the foregoing table.

The agreement is not altogether satisfactory, as shown by the residuals—in fact, it would, perhaps, have been better to make a strictly empirical adjustment. However, no appreciable difference could have followed in the final treatment of the latitudes.

No correction has been applied for periodic errors. A former attempt to determine this correction by means of Harkness' measuring engine was not successful; it seemed to be quite small, and it will be pretty effectually eliminated from the mean of a considerable number of measurements.

The Star List.

The derivation of the best attainable values of the star declinations employed has formed a relatively small part of a more extended undertaking, viz.: that of investigating the coördinates of all stars employed in the latitude work of the Sayre Observatory.

This subject will not be treated in detail at present, as the plan involves a more extended presentation in another place.

In the star list which follows the coördinates of those stars found in Newcomb's Fundamental Catalogue * were taken from that publication, but were reduced to the system of Auwers. The declinations of the remaining stars were deduced from what is believed to be practically all existing material, including observations made at the Lick Observatory, kindly furnished in advance of publication by R. H. Tucker. The reduction to Auwers' system has been applied in all cases where such was available. In case of a few of the newer series where this relation had not been investigated the Catalogue places were employed directly, but with a somewhat diminished weight.

It is not to be inferred that the system of Auwers is considered superior to that of Newcomb, but as this is the system more generally used in latitude work of this character, its employment here renders the results more directly comparable with those obtained elsewhere than would otherwise be the case. In the two pages which follow are found the mean coördinates for 1875, with elements of reduction to any epoch which appear to call for no explanation. The numbers are those of the British Association Catalogue. Those stars marked *N* were taken from Newcomb's Catalogue.

This list is followed by a second, giving the mean places for 1894 and 1895. The reduction to apparent place is as follows:

$$\tfrac{1}{2}(\delta+\delta') = \tfrac{1}{2}(\delta_0+\delta_0') + \tfrac{1}{2}(\mu'+\mu'_1)\,\tau + \tfrac{1}{2}(a'+a'_1)\,A + \tfrac{1}{2}(b'+b'_1)\,B + \tfrac{1}{2}(c'+c'_1)\,C + \tfrac{1}{2}(d'+d'_1)\,D$$

δ and δ' being the apparent declinations required,
δ_0 and δ_0' the mean declinations here given.

A, *B*, *C* and *D* are taken from the American Ephemeris, where the significance of the remaining symbols may be found.

* Catalogue of Fundamental Stars for 1875 and 1900 reduced to an absolute system; Astronomical Papers prepared for the use of the American Ephemeris and Nautical Almanac, Vol. VIII, Part II.

	Star.	Mag.	Right Ascension, 1875.	$\frac{da}{dt}$	$\frac{d^2a}{dt^2}$	μ	Declination, 1875.	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$	μ'	
			h m s				° ′ ″					
Group I.	(1) 1751	5.5	5 29 55.00	+ 5.9977	+ 00027		65 37 34.15	+ 2.5911	—.008683	— .136	— .0337	
	1821	6.0	5 39 34.23	3.4478	+ 4	— .0006	15 46 17.27	1.7864	— 5015	— .021	+ .0011	
	(2) 1862	6.0	5 45 16.25	+ 3.4068	+ 3	— .0015	14 8 16.31	+ 1.2898	— 4960	— .014	+ .0018	
	1874	7.0	5 47 50.68	6.2172	+ 12		66 59 52.43	1.0174	— 9059	— .053	— .0457	
	(3) 1923	6.0	5 54 17.28	+ 4.3250	+ 3	+ .0105	42 54 45.79	+ 0.3511	— 6323	— .006	— .1487	
	1942	6.0	5 57 58.14	4.1343	+ 2	— .0010	38 29 28.93	0.1357	— 6028	+ .002	— .0420	
	(4) 1970	6.5	6 2 0.21	+ 3.6148	+ 1	— .0032	22 12 28.27	— 0.1745	— 5266	+ .006	+ .0008	
	2007	4.3	6 8 35.62	5.3013	— 4	+ .0009	59 3 10.51	— 0.7247	— 7724	+ .039	+ .0271	N
	(5) 2045	5.5	6 15 53.97	+ 5.2422	— 8	— .0050	58 28 56.15	— 1.3973	— 7613	+ .064	— .0072	
	2101	7.5	6 22 49.04	3.6267	— 1		22 37 32.72	— 1.9912	— 5254	+ .034	+ .0021	
	(6) 2139	6.7	6 27 57.13	+ 4.1295	— 5		38 32 37.82	— 2.4613	— 5967	+ .057	— .0215	
	2159	5.1	6 30 24.17	4.2891	— 7	— .0013	42 35 46.54	— 2.7119	— 6187	+ .069	— .0594	
	(7) 2187	5.1	6 35 11.25	+ 5.3101	— 20	— .0110	59 33 53.72	— 3.0706	— 7624	+ .135	— .0037	
	2233	6.0	6 44 3.54	3.5985	— 4	— .0015	21 54 23.21	— 3.8614	— 5133	+ .060	— .0298	
	(8) 2301	6.5	6 55 33.66	+ 3.8211	— 9	+ .0132	29 32 40.18	— 5.6255	— 5408	+ .091	— .8112	
	2341	5.6	7 3 38.30	4.6964	— 23		51 37 59.68	— 5.4925	— 6563	+ .171	+ .0048	
	(9) 2365	7.7	7 7 48.05	+ 5.2023	— 38	— .0100	59 8 14.81	— 5.8709	— 7218	+ .237	— .0243	
	2410	3.6	7 12 39.39	3.5900	— 7	— .0009	22 12 37.58	— 6.2573	— 4946	+ .095	— .0056	N
	(10) 2439	5.8	7 17 51.28	+ 6.3099	— 83	+ .0016	68 43 2.93	— 6.7301	— 8650	+ .438	— .0479	N
	2473	4.8	7 22 50 27	3.3439	— 5	— .0002	12 15 47.15	— 7.1017	—.004531	+ .088	— .0099	N
Group II.	(1) 4694	7.2	14 0 53.56	+ 2.6607	— 4		31 26 53.82	—17.4277	+.002028	+ .101	— .0994	
	4701	6.0	14 3 37.04	2.2455	— 6	— .0070	50 2 58.10	—17.1566	+ 1751	+ .066	+ .0504	
	(2) 4728	6.0	14 9 21.04	+ 2 4259	— 5		42 6 22.85	—17.0451	+ 1965	+ .079	— .1011	
	4758	6.0	14 14 39.72	2 4642	— 4		39 22 9.29	—16.6933	+ 2064	+ .081	— .0024	
	(3) 4825	6.2	14 29 31.88	+ 2.4567	— 2		37 10 33.39	—15.9886	+ 2244	+ .078	— .0536	
	4841	6.	14 33 30.82	2.2570	— 2	— .0086	44 10 55.50	—15.6918	+ 2104	+ .064	+ .0293	
	(4) 4874	6.2	14 38 56.36	+ 1.4902	+ 10	+ .0115	61 47 42.71	—15.4542	+ 1466	+ .045	— .0323	
	4905	4.6	14 45 37.48	2.7670	+ 2	+ .0100	19 37 14.04	—15.1218	+ 2743	+ .102	— .0803	N
	(5) 4926	5.7	14 50 19 27	+ 2.8287	+ 4	— .0020	14 57 9.49	—14.7674	+ 2853	+ .106	— .0009	N
	4949	4 9	14 55 36.08	0.9348	+ 29	— .0124	66 25 50.42	—14.4330	+ 995	+ .058	+ .0170	N
	(6) 4974	4.9	14 59 40.35	+ 1.9810	+ 2	— .0376	48 8 30.82	—14.1646	+ 2062	+ .049	+ .0361	N
	5000	7.2	15 5 34.98	2.4302	— 1		33 33 11.89	—13.8332	+ 2626	+ .070	— .0023	
	(7) 5072	5.3	15 16 48.30	+ 2.4004	+ 1	— .0050	33 22 55.55	—13.0931	+ 2701	+ .065	+ .0104	
	5113	6.7	15 25 24.60	1.9067	+ 4		48 8 35.78	—12.5294	+ 2226	+ .044	— .0050	
	(8) 5147	5.9	15 29 10.63	+ 0.8277	+ 26	— .0140	64 37 46.26	—12.1847	+ 993	+ .057	+ .0806	
	5180	5.8	15 35 14.29	2.7536	+ 4	— .0005	16 25 44.63	—11.8507	+ 3291	+ .082	— .0093	
	(9) 5210	6.5	15 39 26.97	+ 1.6301	+ 7	— .0040	52 45 22.11	—11.5069	+ 1989	+ .038	+ .0352	
	5236	6.0	15 48 25.40	2.4704	+ 3		28 32 28.75	—11.2549	+ 3030	+ .062	+ .0011	
	(10) 5271	4 6	15 48 21.29	+ 2.0728	+ 2	+ .0400	42 48 8.18	—10.2675	+ 2634	+ .042	+ .6288	N
	5295	5.5	15 51 14.70	2.1821	+ 3	+ .0037	38 18 32.54	—10.5979	+ 2744	+ .046	+ .0844	

	Star.	Mag.	Right Ascension, 1875.	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	μ	Declination, 1875.	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^2}{6}\frac{d^3\delta}{dt^3}$	μ'	
			h m s				° ′ ″					
Group III.	(1) 5941	2.3	17 29 7.97	+ 2.7828	00003	.0080	12 39 9.19	− 2.9181	.001045	− .021	− .2256	N
	(1) 6006	4.9	17 37 43.11	− 0.3592	11	.0018	68 18 55.94	− 1.6341	510	.027	.3151	N
	(2) 6122	5.8	17 57 21.18	− 1.0456	6	.0006	72 0 59.20	0.2394	− 1523	.016	− .0078	
	(2) 6143	3.7	18 1 25.11	+ 2.8129	2	− .0045	9 32 51.52	0.2215	4139	− .002	.0969	N
	(3) 6193	6.0	18 8 51.62	+ 1.9987	2	− .0017	38 11 23.70	0.7838	2907	− .002	.0043	
	(3) 6203	5.3	18 11 45.55	+ 1.8644	2	− 0007	42 7 3.70	1.0309	2710	− .002	.0024	N
	(4) 6232	6.5	18 15 2.80	2.3170	2	.0030	29 36 47.62	1.3259	3370	− .006	.0102	
	(4) 6258	6.0	18 18 33.05	1.4121	1		51 14 28.25	1.6091	2046	− .002	− .0122	
	(5) 6373	6.5	18 36 53.24	0.7307	− 4		60 35 43.03	3.2589	1038	− .012	.0451	
	(5) 6387	1.3	18 40 16.96	2.5800	2	− 0020	20 25 41.21	3.1726	3687	− .022	− .3341	N
	(6) 6476	6.0	18 51 29.30	1.5800	0	− .0085	18 42 13.81	4.3436	2215	− .012	− .1240	
	(6) 6491	3.3	18 54 16.09	2.2432	1	− 0005	32 31 9.37	4.7073	3159	− .023	.0029	N
	(7) 6534	5.7	19 0 12.14	2.2792	1		31 33 32.09	5.1369	3188	− .025	− .0706	
	(7) 6579	6.0	19 8 50.81	1.5553	− 3	− .0153	49 37 16.27	6.5575	2120	− .022	.6234	
	(8) 6599	4.5	19 12 1.82	2.0805	1	− .0015	37 54 43.78	6.2136	2857	− .026	.0140	N
	(8) 6656	6.5	19 19 59.51	1.8974	1	0027	43 8 42.92	6.8221	2574	− .024	− .0362	
	(9) 6697	3.9	19 26 33.26	1.5140	− 2	.0021	51 27 51.02	7.5200	2028	− .024	.1250	N
	(9) 6710	4.0	19 34 26.30	+ 2.3667	1	− 0021	29 51 58.67	8.0786	3125	− .042	.0468	
Group IV.	(1) 7509	7.3	21 28 59.03	− 0.1756	− 107		75 51 14.56	15.8451	225	− .160	− .0107	
	(1) 7522	5.8	21 32 16.21	3.0046	− 2	0056	5 12 30.91	16.0610	2569	− .135	.0308	
	(2) 7561	2.5	21 38 2.80	2.9467	− 1	0016	9 18 9.89	16.3381	2426	− .129	.0093	N
	(2) 7597	5.0	21 41 32.10	0.7568	− 41	− 0126	71 44 50.27	16.4608	546	− .065	− .0433	
	(3) B.D.59.2444	7.4	21 55 23.04	1.8887	7		59 41 56.30	17.1664	1351	− .048	.0044	
	(3) 7712	6.0	22 1 58.16	2.8144	5	− 0038	21 5 42.22	17.3875	1944	− .119	− .0655	
	(4) 7760	6.2	22 7 47.39	1.3892	− 10		69 30 55.01	17.7057	877	− .042	.0075	
	(4) 7796	5.1	22 15 21.95	2.9526	2	.0011	11 34 33.48	18.0168	1822	− .139	.0166	N
	(5) 7820	5.0	22 19 27.00	2.4198	15	− .0027	48 50 35.16	18.1416	1419	− .080	− .0133	
	(5) 7843	5.5	22 24 18.86	2.7378	11	.0034	31 55 59.80	18.3258	1542	− .113	− .0058	N
	(6) 7915	6.0	22 35 53.01	2.6777	15	0020	39 34 22.44	18.7157	1322	− .107	− .0029	
	(6) 7932	5.1	22 38 31.18	2.6612	16	− 0012	41 9 49.01	18.8149	1271	− .106	.0148	N
	(7) 7962	6.0	22 44 43.70	2.6935	17		41 17 30.61	18.9762	1185	− .110	− .0061	
	(7) 7978	6.7	22 47 28.86	2.7275	16	− .0018	39 30 12.46	19.0465	1155	− .114	− .0121	
	(8) 8024	6.5	22 56 14.00	2.5188	26		56 26 3.21	19.2766	926	− .092	− .0064	
	(8) 8052	4.5	23 1 1.50	2.9141	11	− 0010	24 47 38.07	19.3660	998	− .140	− .0279	
	(9) 8078	5.2	23 5 25.57	3.0270	3	− 0007	8 2 29.52	19.5022	957	− .157	.0139	N
	(9) 8122	6.8	23 13 22.01	2.1787	40	− 0096	73 0 21.60	19.6084	555	− .063	− .0321	
	(10) 8195	6.0	23 25 8.80	2.9332	21	0223	38 32 58.87	19.7497	567	− .144	− .0731	
	(10) 8229	4.3	23 32 0.62	2.9250	25	0024	42 34 34.12	19.9075	434	− .144	.0026	N
	(11) 8252	6.5	23 37 0.68	2.8950	35	− 0030	52 27 33.04	19.9492	336	− .139	− .0042	
	(11) 8284	6.0	23 43 19.97	3.0239	16	0036	28 8 47.79	20.0206	235	− .159	.0194	
	(12) 8317	7.5	23 49 18.36	2.9744	44	− 0028	56 42 59.50	20 0216	116	− .151	− .0108	
	(12) 8324	4.8	23 51 24.51	3.0464	15	− 0031	24 26 47.38	20.0143	80	− .163	− .0258	N

	Pair.	α1894.	1895.	δ1894.	1895.	Zenith Distance, 1894.		S−N.
		h m s	s	° ′ ″	″	° ′ ″		′ ″
Group I.	(1)	5 31 49.01	55.01	65 38 21.82	24.24	25 1 58	N	
		5 40 39.75	43.20	15 46 50.30	51.99	24 49 34	S	— 12 24
	(2)	5 46 20.98	24.39	14 8 39.92	41.11	26 27 44	S	
		5 49 48.83	55.05	67 0 10.13	10.97	26 23 46	N	+ 3 58
	(3)	5 55 39.46	43.79	42 54 51.33	51.55	2 18 27	N	
		5 59 16.70	20.83	38 29 30.42	30.44	2 6 54	S	— 11 33
	(4)	6 3 8.89	12.50	22 12 24.01	23.73	18 24 0	S	
		6 10 16.34	21.64	59 2 55.35	54.47	18 26 31	N	— 2 31
	(5)	6 17 33.56	38.80	53 28 28.23	26.68	17 52 4	N	
		6 23 57.95	61.58	22 36 53.95	51.85	17 59 30	S	+ 7 26
	(6)	6 29 15.58	19.71	33 31 49.98	47.40	2 4 34	S	
		6 31 45.66	49.95	42 34 53.90	51.06	1 58 30	N	+ 6 4
	(7)	6 36 52.11	57.42	59 32 54.00	50.78	18 56 30	N	
		6 45 11.90	15.50	21 53 8.92	4.96	18 43 15	S	— 13 15
	(8)	6 56 46.24	50 06	29 30 52.32	46.59	11 5 32	S	
		7 5 7.49	12.18	51 36 14.14	8.52	10 59 50	N	+ 5 42
	(9)	7 9 26.83	32.03	59 6 21.97	15.95	18 29 58	N	
		7 13 47.59	51.18	22 10 37.80	31.44	18 25 46	S	— 4 12
	(10)	7 19 51 02	57.31	68 40 53.50	46.60	28 4 30	N	
		7 23 53.79	57.13	12 13 31.40	24.21	28 22 53	S	+ 18 23
Group II.	(1)	14 1 44.11	46.77	31 21 23.06	5.67	9 15 1	S	
		14 4 19.69	21.93	49 57 32.44	15.32	9 21 8	N	— 6 7
	(2)	14 10 7.12	9.55	42 0 59.35	42.34	1 24 35	N	
		14 15 26.53	28.99	39 16 52.49	35.84	1 19 32	S	— 5 3
	(3)	14 30 18.55	21.01	37 5 30.01	14.07	3 30 54	S	
		14 34 13.70	15.96	44 5 57.73	42.08	3 29 34	N	+ 1 20
	(4)	14 39 24.69	26.18	61 42 49.34	33.92	21 6 25	N	
		14 46 30.06	32.83	19 32 27.22	12.15	21 3 57	S	— 2 28
	(5)	14 51 13.02	15.85	14 52 29.42	14.71	25 43 55	S	
		14 55 53.89	54.83	66 21 16.37	1.96	25 44 52	N	— 0 57
	(6)	15 0 17.99	19.97	48 3 62.06	47.94	7 27 38	N	
		15 6 21.15	23.58	33 28 49.53	35.76	7 7 34	S	— 20 4
	(7)	15 17 33.91	36.31	33 18 47.27	34.23	7 17 37	S	
		15 26 0.83	2.74	48 4 38.12	25.64	7 28 14	N	— 10 37
	(8)	15 29 26.40	27.23	64 33 54.93	42.76	23 57 31	N	
		15 36 6.62	9.37	16 21 60.06	48.27	24 14 24	S	+ 16 53
	(9)	15 39 57.96	59.59	52 41 43.84	32.37	12 5 20	N	
		15 44 12.34	14.81	28 28 55 45	44.26	12 7 29	S	+ 2 9
	(10)	15 49 0.68	2.75	42 44 53.57	43.36	2 8 30	N	
		15 51 56.17	58.35	38 15 11.67	1.13	2 21 12	S	+ 12 42

	Pair.	α1894.	1895.	δ1894.	1895.	Zenith Distance, 1894.		S—N.
		h m s	s	° ′ ″	″	° ′ ″		′ ″
Group III.	(1)	17 30 0.85	3.63	12 38 14.47	11.63	27 58 10	S	
		17 37 34.30	33.94	68 48 24.79	23.15	28 12 1	N	— 13 51
	(2)	17 57 1.33	0.29	72 0 54.38	54.11	31 24 30	N	
		18 2 19.46	22.30	9 32 56.48	56.78	31 3 28	S	— 21 2
	(3)	18 9 32.60	34.60	38 44 38.12	38.96	1 51 46	S	
		18 12 20.98	22.84	42 7 23.77	24.86	1 31 0	N	+ 20 46
	(4)	18 15 46.83	49.15	29 37 13.42	14.81	10 59 11	S	
		18 18 59.89	61.30	51 14 59.19	60.84	10 38 35	N	+ 20 36
	(5)	18 37 7.12	7.85	60 36 45.14	48.42	20 0 21	N	
		18 41 5.98	8.56	20 26 42.15	45.40	20 9 42	S	+ 9 21
	(6)	18 51 59.32	60.90	48 43 36.73	41.12	8 7 13	N	
		18 54 58.71	60.95	32 32 39.38	44.15	8 3 45	S	— 3 28
	(7)	19 0 55.45	57 73	31 35 10.27	15.47	9 1 14	S	
		19 9 20.36	21.91	49 39 21.24	27.84	9 2 57	N	— 1 43
	(8)	19 12 41.35	43.43	37 56 42.35	48.62	2 39 42	S	
		19 20 35.56	37.46	43 10 53.01	59.88	2 34 29	N	+ 5 13
	(9)	19 27 2.02	3.53	51 30 14.27	21.83	10 53 50	N	
		19 35 11.27	13.64	29 54 32.73	40.87	10 41 51	S	— 11 59
Group IV.	(1)	21 28 55.50	55.30	75 56 15.58	31.42	35 19 52	N	
		21 33 13.29	16.29	5 17 36.53	52.64	35 18 47	S	— 1 5
	(2)	21 38 58.79	61.74	9 23 20.75	37.14	31 13 3	S	
		21 41 46.41	47.16	71 50 8.13	19.60	31 13 39	N	— 0 36
	(3)	21 55 58.94	60.83	59 47 22.71	39.90	19 10 59	N	
		22 2 51.64	54.46	21 11 12.93	30.36	19 25 11	S	+ 14 12
	(4)	22 8 13.77	15.16	69 36 31.58	49.30	29 0 8	N	
		22 16 18.05	21.00	11 40 16.13	34.18	28 56 8	S	— 4 0
	(5)	22 20 13.00	15.42	48 56 20.11	38.28	8 19 56	N	
		22 25 10.90	13.64	32 1 48.26	66.62	8 34 36	S	+ 14 40
	(6)	22 36 43.91	46.59	39 40 18.28	37.02	0 56 6	S	
		22 39 21.83	24.50	41 15 46.72	65.56	0 39 23	N	+ 16 43
	(7)	22 45 34.91	37.61	41 23 31.37	50.37	0 47 7	N	
		22 48 20.71	23.44	39 36 14.55	33.62	1 0 9	S	+ 13 2
	(8)	22 57 1.90	4.42	56 32 9.63	28.93	15 55 46	N	
		23 1 56.89	59.81	24 53 46.20	65.59	15 42 38	S	— 13 8
	(9)	23 6 23.09	26.12	8 8 40.24	59.76	32 27 44	S	
		23 14 3.51	5.69	73 6 34.26	53.88	32 30 10	N	— 2 26
	(10)	23 26 4.57	7.51	38 39 14.22	33.98	1 57 10	S	
		23 32 56.24	59.17	42 40 52.44	72.36	2 4 28	N	— 7 18
	(11)	23 37 55.75	58.65	52 33 52.13	72.09	11 57 28	N	
		23 44 17.45	20.48	28 15 8.22	28.25	12 21 16	S	+ 23 48
	(12)	23 50 14.95	17.93	56 49 19.94	39.96	16 12 56	N	
		23 52 22.42	25.47	24 33 7.66	27.68	16 3 16	S	— 9 40

The Latitude Observations.

The details of the latitude determination are found in the pages following. The expression for the latitude is—

$$\phi = \tfrac{1}{2}(\delta + \delta') + \tfrac{1}{2}R(M - M') + \tfrac{1}{4}d[(n - n') - (s' - s)] + (m + m') + \tfrac{1}{2}(r - r')$$

M and M' are the corrected readings of the micrometer.

n, s, n', s', the readings of the north and south end of the level for the two stars.

m, m', corrections for curvature.

r, r', corrections for refraction.

The contents of most of the columns will be sufficiently explained by the headings.

Column P gives the position of the instrument.

D, direct, the telescope east when pointing south of the zenith.

R, reverse, the telescope west when pointing south of the zenith.

Column C gives the correction for progressive errors of the screw.

Levels A and B, the value of $(n—n') — (s'—s)$ for each level.

Column δ gives the correction required on account of $\Delta\frac{1}{2}R$, found on page 83. In case of those pairs observed with threads II and IV this is combined with the correction for the amount by which the distance between those threads differs from twenty revolutions of the screw.

Throughout this table the footnote references *a*, *b*, *c*, and *d* indicate as follows: *a* c. c. f.; *b* = definition very poor; *c* = levels discordant; *d* = clouds.

1894	Star.		P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
									° ′ ″						° ′ ″	°
Jan. 19	I	1	D	27.8237	12.6470	+ 31	—2.9	—3.4	40 42 48.42	—6 23.56	— 60	— 90	—13	8	40 36 23.31	30.6
		2		24.6583	20.4470	+ 94	—4.0	—2.0	40 34 36.71	+1 46.65	+ 17	— 90	+ 4	8	22.75	
		3		30.1117	15.9673	+374	+1.2	+ .8	40 42 22.54	—5 58.34	— 56	+ 30	—10	6	23.90	
		4		18.5863	22.0447	+ 8	+1.3	+ .1	40 37 50.67	—1 27.41	— 14	+ 23	— 3	7	23.39	31.6
		5		17.1530	25.5403	+ 97	— .2	—1.3	40 32 51.48	+3 32.17	+ 33	— 20	+ 7	7	23.92	
		6		25.1847	18.3807	+106	—4.5	—4.4	40 33 31.80	+2 52.19	+ 26	—1.28	+ 5	6	23.08	
		7		29.3270	13.2580	+191	+ 1.0	+ 1.0	40 43 10.77	—6 46.48	— 64	+ 29	—12	7	23.89	
		8		23.8183	17.3970	+ 34	—2.9	—2.9	40 33 41.17	+2 42.34	+ 25	— 84	+ 5	6	23.03	30.6
		9		22.2030	16.9083	— 21	—1.6	—2.0	40 38 37.24	—2 13.73	— 21	— 51	— 4	7	22.82	
Jan. 25		10		7.5603 ii	29.0650 iv	— 24	—1.5	—1.2	40 27 19.29	+9 3.31	+ 83	— 40	+ 20	9	23.32	29.6
	I	1	R	14.0800	29.3317	+227	+ .9	+ .7	40 42 49.16	—6 25.95	— 60	+ 26	—13	8	22.82	21.5
		2		19.9213	24.0473	+ 70	+ 1.9	+ .9	40 34 37.46	+1 44.43	+ 17	+ 42	+ 4	8	22.60	
		3		14.6907	28.9170	+222	— .1	+ .4	40 42 23.36	—6 0.03	— 56	+ 3	—10	6	22.76	21.0
		4		24.2683	20.7807	+ 77	+1.5	+1.6	40 37 51.48	—1 28.32	— 14	+ 44	— 3	7	23.50	21.0
		5		24.8627	16.5750	+ 52	+ 1.6	+ 1.5	40 32 52.30	+3 29.54	+ 33	+ 45	+ 7	7	22.76	
		6		16.3180	23.0093	— 22	+ 1.7	+ 1.2	40 33 32.66	+ 2 49.02	+ 26	+ 45	+ 5	6	22.50	
		7		12.1583	28.3080	+ 32	+ .7	+ .6	40 43 11.61	—6 48.15	— 64	+ 18	—12	7	22.95	
		8		17.2093	23.5427	+ 20	+2.0	+1.5	40 33 42.02	+ 2 40.08	+ 25	+ 52	+ 5	6	22.98	20.2
		9		18.1737	23.5317	+ 40	— .3	+ .3	40 38 38.11	—2 15.48	— 21	— 1	— 4	7	22.44	
		10		31.7237 iv	10.2847 ii	+ 12	—2.1	— .2	40 27 20.05	+9 1.74	+ 83	— 36	+ 20	9	22.55	20.6
Jan. 27	I	1	D	27.6193	12.3807	— 1	— .7	—2.2	40 42 49.29	—6 25.04	— 60	— 41	—13	8	23.19	26.8
		2		22.0680	17.9097	0	+1.1	+ .1	40 34 37.62	+ 1 45.07	+ 17	+ 17	+ 4	8	23.15	
		3		27.3453	13.1350	+ 30	—1.0	+1.2	40 42 23.54	—5 59.14	— 56	— 31	—10	6	23.49	26.4
		4		17.1290	20.6350	— 34	+ .6	— .3	40 37 51.66	—1 28.50	— 14	+ 6	— 3	7	23.12	
		5		15.3263	23.6640	— 37	0	+ .2	40 32 52.49	+3 30.58	+ 33	+ 2	+ 7	7	23.56	
		6		23.2457	16.5013	— 7	— .8	—1.8	40 33 32.86	+2 50.40	+ 26	— 37	+ 5	6	23.26	26.8
		7		27.9270	11.8237	— 22	—1.9	—1.8	40 43 11.80	—6 46.84	— 64	— 55	—12	7	23.72	26.6
		8		23.3103	16.9490	+ 7	—1.3	— .5	40 33 42.24	+2 40.75	+ 25	— 26	+ 5	6	23.09	
		9		21.9970	17.6553	— 8	+ .2	+ .9	40 38 38.33	—2 14.95	— 21	+ 14	— 4	7	23.34	
		10		8.3810 ii	29.8150 iv	— 11	0	0	40 27 20.25	+9 1.56	+ 83	0	+ 20	9	22.93	
Jan. 27	II	1	D	15.6303	22.0747	— 64	—1.5	—1.2	40 39 6.40	—2 42.67	— 25	— 41	— 5	6	23.08	23.8
		2		23.7070	18.5513	+ 34	+ .9	+ .5	40 38 34.01	—2 10.36	— 20	+ 22	— 3	6	23.70	
		3		21.9730	19.5720	+ 15	+ .7	— .1	40 35 21.41	+1 0.71	+ 10	+ 10	+ 2	6	22.40	
		4		19.7397	17.6017	— 25	— .6	+1.0	40 37 16.62	— 53.95	— 8	+ 3	— 2	7	22.67	
		5		19.4913	19.8543	— 1	+2.2	+1.7	40 36 31.45	— 9.17	— 1	+ 57	— 0	9	22.93	22.6
		6		31.2783 iv	8.3383 ii	— 5	+1.6	+1.6	40 46 2.72	—9 39.63	— 88	+ 48	—17	6	22.58	
		7		14.6627	26.3770	+ 53	— .5	+ .6	40 41 19.42	—4 56.13	— 46	+ 1	— 8	6	22.82	
Jan. 28		8		9.5983 ii	30.4910 iv	0	+ .9	— .6	40 27 35.41	+8 47.91	+ 81	+ 7	+ 17	8	24.45	22.6
	I	1	R	12.5893	27.8300	+ 26	+ .5	+ .8	40 42 49.35	—6 25.16	— 60	+ 18	—13	8	23.72	24.0
		2		19.0140	23.1793	+ 41	+ .1	— .5	40 34 37.67	+1 45.35	+ 17	— 5	+ 4	8	23.26	
		3		13.6527	27.8787	+ 91	— .1	+ .8	40 42 23.60	—5 59.69	— 56	+ 9	—10	6	23.40	
		4		23.6663	20.1833	+ 58	+ 1.5	+ 1.5	40 37 51.73	—1 28.15	— 14	+ 43	— 3	7	23.91	
		5		23.9243	15.5990	— 19	— .3	+ .2	40 32 52.56	+3 30.31	+ 33	— 2	+ 7	7	23.32	*a*
		6		17.0703	23.7873	+ 26	— .4	— .9	40 33 32.95	+ 2 49.79	+ 26	— 20	+ 5	6	22.91	
		7		13.7950	29.9000	+259	—1.6	— .9	40 43 11.88	—6 47.59	— 64	— 38	—12	7	23.22	22.3
Jan. 30	I	1	D	24.8433	9.5513	—373	—1.8	—1.0	40 42 49.44	—6 25.45	— 60	— 40	—13	8	22.94	32.6
		2		22.4630	18.3093	+ 14	—1.2	—2.9	40 34 37.78	+1 44.99	+ 17	— 56	+ 4	8	22.50	
		3		26.3643	12.0900	— 96	+1.4	+ .5	40 42 23.73	—6 0.43	— 56	+ 29	—10	6	22.99	
		4		17.9990	21.5027	— 6	— .8	—1.5	40 37 51.85	—1 28.51	— 14	— 34	— 3	7	22.90	
		5		16.8840	25.1503	+ 73	+ .8	+ .8	40 32 52.69	+3 29.05	+ 33	+ 24	+ 7	7	22.45	32.3
	I	6		23.8970	17.1903	+ 32	— .6	—1.2	40 33 33.09	+2 49.54	+ 26	— 25	+ 5	6	40 36 22.75	32.4
		7		28.1793	12.0373	+ 16	—2.0	— .5	40 43 12.02	—6 47.91	— 64	— 38	—12	7	23.04	31.6
		8		22.1067	15.7443	— 61	—1.0	—1.0	40 33 42.48	+2 40.61	+ 25	— 29	+ 5	6	23.16	
		9		22.5473	17.2050	— 6	—1.2	—1.7	40 38 38.56	—2 14.97	— 21	— 41	— 4	7	23.00	
		10		8.1260 ii	29.5650 iv	— 13	+ .5	+ .7	40 27 20.46	+9 1.68	+ 83	+ 17	+ 20	9	23.43	31.1

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
								° ′ ″						° ′ ″	°
Jan. 31	I 1	R	11.4543	26.7167	—124	— .4	— .9	40 42 49.50	—6 25.33	— 60	— 20	—13	8	40 36 23.32	28.
	2		17.9183	22.1020	0	—2.1	—2.1	40 34 37.84	+1 45.71	+ 17	— 62	+ 4	8	23.22	
	4		22.3530	18.8797	+ 18	+ .6	—1.0	40 37 51.93	—1 27.81	— 14	— 3	— 3	7	23.99	28.7
	5		24.9987	16.6793	+ 59	—2.0	—1.1	40 32 52.76	+3 30.36	+ 33	— 45	+ 7	7	23.14	
	6		16.7357	23.4720	+ 6	— .3	—1.2	40 33 33.18	+2 50.22	+ 26	— 22	+ 5	6	23.55	
	7		12.4090	28.5417	+ 66	— .6	— .0	40 43 12.10	—6 47.80	— 64	— 8	—12	7	23.53	
	8		17.7410	24.0937	+ 51	+ .4	+ .6	40 33 42.56	+2 40.65	+ 25	+ 12	+ 5	6	23.69	27.5
	9		18.1583	23.5107	+ 40	— .4	— .2	40 38 38.65	—2 15.34	— 21	— 9	— 4	7	23.04	
Feb. 10			32.2200iv	10.8167 ii	+ 19	+1.2	+1.8	40 27 20.54	+9 0.86	+ 83	+ 42	+20	9	22.94	28.4
1 II	1	R	22.9023	16.4937	— 18	—2.2	—2.2	40 39 5.94	—2 41.88	— 25	— 66	— 5	6	23.16	23.4
	2		18.4417	23.5673	+ 45	—1.0	— .4	40 38 33.51	—2 9.63	— 20	— 21	— 3	6	23.50	
	3		19.4670	21.9317	+ 14	— .4	+ .1	40 35 20.83	+1 2.31	+ 10	— 5	+ 2	6	23.27	
	4		20.5023	22.5873	+ 28	— .1	— .6	40 37 16.04	— 52.75	— 8	— 9	— 2	7	23.17	23.2
	5		21.7963	21.4990	+ 4	+ .2	+ .3	40 36 30.93	— 7.52	— 1	— 1	0	9	23.48	
	6		9.1133 ii	31.9680iv	+ 17	—1.7	—2.0	40 46 2.04	—9 37.53	— 88	— 56	—17	6	22.96	
	7		26.7263	15.0633	+ 92	+1.7	+ .5	40 41 18.66	—4 54.93	— 46	+ 33	— 8	6	23.58	23.1
	8		31.5433iv	10.6517 ii	+ 8	+ .4	0	40 27 34.67	+8 47.90	+ 81	+ 8	+ 17	8	23.71	
Feb. 10			27.2713iv	11.2683 ii	+ 25	—1.2	—1.5	40 29 38.32	+6 44.42	+ 61	— 38	+11	7	23.15	
4 II	1	D	16.1913	22.6443	— 33	+1.1	+1.9	40 39 5.63	—2 42.97	— 25	+ 45	— 5	6	22.87	13.2b
	2		23.3880	18.2530	+ 37	+1.1	+ .2	40 38 33.17	—2 9.84	— 20	+ 20	— 3	6	23.36	
Feb. 3			20.8503	18.3943	— 9	—1.3	— .9	40 35 20.44	+1 2.03	+ 10	— 33	+ 2	6	22.32	12.3
5 I	1	D	27.4927	12.1777	— 22	+ .5	+ .3	40 42 50.00	—6 26.92	— 60	+ 12	—13	8	22.55	18.2
	2		22.6073	18.4380	+ 19	—1.5	—2.4	40 34 38.37	+1 45.40	+ 17	— 55	+ 4	8	23.51	
	4		17.8907	21.4060	— 10	—1.6	—1.1	40 37 52.49	—1 28.80	— 14	— 40	— 3	7	23.19	
	5		17.0087	25.3177	+ 85	—1.3	—1.5	40 32 53.36	+3 30.16	+ 33	— 40	+ 7	7	23.59	15.8
	6		24.2170	17.4928	+ 50	—1.8	—1.7	40 33 33.81	+2 50.03	+ 26	— 53	+ 5	6	23.68	
	7		28.7087	13.5730	+ 90	—1.5	—1.1	40 43 12.72	—6 47.94	— 64	— 38	—12	7	23.71	16.6
	8		23.2483	16.9587	+ 7	— .4	— .7	40 33 43.22	+2 38.94	+ 25	— 18	+ 5	6	22.34	
	9		23.1897	17.8510	+ 25	—1.7	—2.0	40 38 39.30	—2 14.96	— 21	— 52	— 4	7	23.64	
	10		9.2247 ii	30.6597iv	0	—1.7	— .6	40 27 21.14	+9 1.61	+ 83	— 34	+20	9	23.53	15.2
Feb. 6 I	1	R	12.7857	28.0720	+ 57	— .1	— .3	40 42 50.11	—6 26.39	— 60	— 7	—13	8	23.00	22
	2		18.3510	22.4823	+ 16	—3.2	—4.6	40 34 38.48	+1 44.43	+ 17	—1.11	+ 4	8	22.09	
	3		13.2433	27.5070	+ 47	— .9	—1.2	40 42 24.52	—6 0.53	— 56	— 30	—10	6	23.09	
	4		22.9643	19.4523	+ 36	+ .7	+ .4	40 37 52.64	—1 28.83	— 14	+ 16	— 3	7	23.87	23.6
	5		24.2867	16.0197	+ 13	+ .3	+2.1	40 32 53.49	+3 28.92	+ 33	+ 32	+ 7	7	23.20	23.5
	6		17.3513	24.0637	+ 41	+ .3	+ .5	40 33 33.95	+2 49.71	+ 26	+ 10	+ 5	6	24.13	
	7		13.0087	29.1663	+154	— 0	— 0	40 43 12.87	—6 48.65	— 64	— 0	—12	7	23.53	23.0
	8		17.7067	24.0000	+ 47	+1.6	+1.4	40 33 43.37	+2 39.14	+ 25	+ 45	+ 5	6	23.32	
	9		17.6847	23.0847	+ 18	+ .1	.0	40 38 39.45	—2 16.49	— 21	+ 3	— 4	7	22.81	*a*
	10		32.4257iv	11.0243 ii	+ 23	— 0	— .2	40 27 21.29	+9 0.82	+ 83	— 2	+20	9	23.21	23.4
Feb. 11 I	1	D	27.9173	12.6390	+ 38	—1.8	—2.5	40 42 50.39	—6 26.14	— 60	— 60	—13	8	23.00	33.5
	2		22.9650	18.8243	+ 32	—1.5	.0	40 34 38.81	+1 44.71	+ 17	— 24	+ 4	8	23.57	
	3		28.1970	13.8757	+130	+2.6	+1.3	40 43 24.90	—6 2.19	— 56	+ 57	—10	6	22.68	
	4		18.0300	21.5780	— 5	— .9	—2.3	40 37 53.04	—1 29.64	— 14	— 44	— 3	7	22.86	33.3
	5		16.5260	24.7923	+ 47	— .5	— .1	40 32 53.92	+3 28.99	+ 33	— 11	+ 7	7	23.27	
	7		29.4467	13.2903	+193	— .5	—1.9	40 43 13.35	—6 48.72	— 64	— 31	—12	7	23.63	
I	8		23.7220	17.4473	+ 32	— .5	—1.5	40 33 43.92	+2 38 63	+ 25	— 27	+ 5	6	22.64	32.1
	9		23.9587	18.5483	+ 59	+ .8	+2.2	40 38 40.00	—2 16 86	— 21	+ 42	— 4	7	23.38	32.6
	10		9.8677 ii	31.2503iv	+ 4	+ .2	— .1	40 27 21.82	+9 0.30	+ 83	+ 1	+ 20	9	23.25	
II	1	D	15.6027	22.0210	— 69	— .8	+ .4	40 39 5.44	—2 42.00	— 25	— 10	— 5	6	23.10	25.2
Feb. 15	2		23.9343	18.8043	+ 60	+ .9	+ .4	40 38 32.92	—2 9.77	— 20	+ 21	— 3	6	23.19	24.8
I	1	R	12.0227	27.3173	— 45	— .8	—1.4	40 42 50.54	—6 26.34	— 60	— 32	—13	8	23.23	27.4
	2		18.6237	22.7487	+ 24	—1.8	— .4	40 34 38.99	+1 44.29	+ 17	— 34	+ 4	8	23.23	
	3		13.3550	27.6370	+ 62	— .6	— .7	40 42 25.12	—6 1.03	— 56	— 17	—10	6	23.32	
	4		23.8620	20.3357	+ 65	—1.3	— .6	40 37 53.27	—1 29.27	— 14	— 27	— 3	7	23.63	26.5

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Feb.								° ′ ″						° ′ ″	°
15	I 5	R	24.9280	16.6793	+ 56	+ .4	— .2	40 32 54.17	+3 28.57	+ 33	+ 2	+ 7	7	40 36 23.23	
	6		17.2970	23.9450	+ 36	—1.1	— .3	40 33 34.71	+2 48.07	+ 26	— 21	+ 5	6	22.94	25.4
	7		13.0220	29.2033	+ 155	— .6	—1.4	40 43 13.62	—6 49.25	— 64	— 29	—12	7	23.39	24.8
	8		17.5477	23.7933	+ 37	+ 1.0	+ 1.3	40 33 44.23	+2 37 90	+ 25	+ 33	+ 5	6	22.82	
	9		18.4893	23.9123	+ 56	— .2	+ .2	40 38 40.31	—2 17.17	— 21	0	— 4	7	22.96	25.3
Feb.															
16	I 1	D	26.2933	11.0240	—177	+ 1.1	—2.2	40 42 50.62	—6 25.37	— 60	— 11	—13	8	[24.49]	16.3*c*
	2		23.2107	19.0543	+ 41	—4.3	—1.0	40 34 39.07	+1 45.13	+ 17	— 82	+ 4	8	[23.67]	*c*
	3		27.7577	13.4470	+ 75	+ 2.3	+ 1.0	40 42 25.21	—6 1.79	— 56	+ 48	—10	6	23.30	*b*
	4		18.2070	21.7377	— 1	— .1	— .5	40 37 53.36	—1 29.21	— 14	— 10	— 3	7	23.95	17.5
	5		16.9117	25.1300	+ 73	2.0	+ 1.8	40 32 54.26	+3 27.84	+ 33	+ 54	+ 7	7	23.11	
	6		24.8087	18.1883	+ 87	1.7	+ .1	40 33 34.82	+2 47.50	+ 26	+ 27	+ 5	6	22.96	
	7		28.1637	11.9810	+ 10	— .2	+ 2.0	40 43 13.72	—6 48.92	— 64	+ 23	—12	7	[24.34]	17.9*c*
	8		23.7047	17.4350	+ 32	+ .6	1.0	40 33 44.34	2 38.50	+ 25	+ 22	+ 5	6	23.42	16.6
	9		24.3793	18.9517	+ 70	- .7	— .3	40 38 40.42	—2 17.32	— 21	- 15	— 4	7	22.77	
	10		9.3317 II	30.7380 IV	— 0	—1.3	—2.3	40 27 22.05	+ 9 0.89	+ 83	— 54	+ 20	9	23.52	
	II 1	D	17.1837	23.5290	+ 20	3.1	—3.1	40 39 5.27	—2 40.38	— 25	— 90	— 5	6	23.75	9.5*b*
	2		23.2423	18.1080	+ 31	— .2	+ .2	40 38 32.72	—2 9.81	- 20	— 5	— 3	6	22.69	
	3		20.7750	18.2593	— 11	— .7	—1.4	40 35 19.79	+ 1 3.54	+ 10	— 29	+ 2	6	23.22	10.4
	4		20.4573	18.4507	- 9	— .9	— .7	40 37 14.90	— 50.68	- 8	— 25	— 2	7	23.94	10.8*b*
	5		18.6610	18.8947	— 4	—1.0	—1.9	40 36 29.64	- 5.89	— 1	— 40	0	9	23.43	
	6		31.6043 IV	8.7930 II	+ 5	— .3	— .2	40 46 0.61	—9 36.40	— 88	— 7	—17	6	23.15	10.2
	7		14.2550	25.8927	+ 7	+ 1.6	+ 3.0	40 41 16.99	—4 54.07	— 46	+ 62	— 8	6	23.06	10.0
	8		9.2690 II	30.1943 IV	— 2	+ 2.5	+ 1.8	40 27 32.97	+8 48.73	+ 81	+ 63	+ 17	8	23.39	
Feb.	10		11.5430	27.6193	+ 15	+ .3	— .3	40 29 36.31	+6 46.25	+ 61	+ 1	+ 11	7	23.36	9.9
19	I 1	R	13.3837	28.7000	+ 139	+ .4	+ .1	40 42 50.88	—6 27.36	— 56	+ 5	—13	8	22.96	36
	2		18.6097	22.7193	+ 23	—1.4	—1.7	40 34 39.36	+1 43.90	+ 15	— 44	+ 4	8	23.09	
Feb.	3		12.8043	27.1183	— 5	—1.1	—1.1	40 42 25.53	—6 1.67	— 53	— 39	—10	6	22.90	36.5
20	I 2	R	17.7277	21.8047	— 9	—1.6	— .8	40 34 39.45	+1 42.99	+ 15	— 39	+ 4	8	22.32	33.9
	3		12.0477	26.3877	- 97	—1.1	0	40 42 25.63	—6 2.09	— 53	— 17	—10	6	22.80	
	4		22.8067	19.2490	+ 32	—1.0	—1.0	40 37 53.79	—1 29.98	— 13	— 27	— 3	7	23.45	34.1
Feb.															
23	I 1	R	11.9477	27.3090	— 50	+ 1.5	+ 1.5	40 42 51.08	—6 28.02	— 56	+ 41	—13	8	22.86	22.5
	2		17.6373	21.6820	— 12	+ 2.6	1.7	40 34 39.60	+1 42.17	+ 15	+ 63	+ 4	8	22.67	
	3		13.3587	27.6937	+ 66	+ 1.3	+ .6	40 42 25.81	—6 2.38	— 53	+ 30	—10	6	23.16	
	4		23.2730	19.6704	+ 46	+ .8	+ .8	40 37 54.00	—1 31.15	- 13	+ 23	— 3	7	22.99	
	5		25.2697	17.0783	+ 84	1.1	— 0	40 32 54.94	+3 27.19	+ 30	— 15	+ 7	7	22.42	22.3
	6		16.7523	23.3610	+ 4	+ 2.1	+ 2.2	40 33 35.57	+2 47.00	+ 24	+ 62	+ 5	6	23.54	*
	7		13.3100	29.5347	+ 201	— .4	+ .3	40 43 14.49	—6 50.47	— 60	— 1	—12	7	23.36	21.4
	8		18.7200	24.9213	- 98	+ 1.5	1.7	40 33 45.21	+2 36.94	+ 23	- 47	+ 5	6	22.96	
	9		18.0897	23.4643	+ 40	1.9	2.4	40 38 41.30	—2 18.43	- 20	+ 61	— 4	7	23.31	
	10		32.1343 IV	10.7993 II	- 17	— .2	+ .2	40 27 23.05	+8 59.13	- 77	— 0	+ 20	9	23.24	20.1
	II 1	D	18.4400	24.8253	+ 91	+ .9	+ .7	40 39 5.44	—2 41.57	- 24	+ 23	— 5	6	23.87	12.0
	2		22.6247	17.4540	+ 2	3.6	+ 3.1	40 38 32.84	—2 10.66	- 19	+ 98	— 3	6	23.00	
	3		20.7480	18.2877	— 10	.4	1.0	40 35 19.78	+1 2.14	+ 9	+ 21	+ 2	6	22.30	11.9
	4		20.1477	18.0977	— 15	— .3	— .1	40 37 14.81	— 51.76	— 8	— 6	— 2	7	22.96	11.6
	5		19.8987	20.1760	+ 1	1.0	+ 1.3	40 36 29.47	— 7.01	— 1	+ 33	— 0	9	22.87	
	6		31.1100 IV	8.2883 II	— 8	+ .9	— .5	40 46 0.42	—9 36.63	— 82	+ 8	—17	6	22.94	11.1
	7		13.8853	25.5263	—152	— .0	+ .8	40 41 16.66	—4 53.76	— 43	+ 10	— 8	6	22.55	
Feb.	10		9.7060 II	25.7673 IV	+ 78	+ .9	— .3	40 29 35.81	+6 46.03	+ 57	+ 10	+ 11	7	22.69	11.1
24	I 1	D	26.8507	11.4800	—112	+ 2.6	+ 1.6	40 42 51.08	—6 28.10	— 56	+ 62	—13	8	22.99	10.3
	2		22.2820	18.2153	+ 9	+ .8	+ .6	40 34 39.62	+1 42.78	+ 15	+ 20	+ 4	8	22.87	
	3		28.2880	13.9393	+ 140	+ 1.9	+ .5	40 42 25.83	—6 2.91	— 53	+ 37	—10	6	22.72	
	4		19.1947	22.7853	+ 31	+ .3	+ .0	40 37 54.03	—1 30.80	— 13	+ 5	— 3	7	23.19	9.9
	5		17.4353	25.6563	+ 112	+ .9	+ .6	40 32 54.98	+3 28.01	+ 30	+ 22	+ 7	7	23.65	
	6		23.3070	16.6973	0	+ .3	+ .8	40 33 35.62	+2 47.01	+ 24	+ 15	+ 5	6	23.13	
	7		28.9093	12.6203	+ 108	+ 3.8	+ 3.0	40 43 14.54	—6 51.86	— 60	+ 1.00	—12	7	23.03	

* Very unsteady.

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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Feb. 24	I 8		22.1140	15.8947	— 54	— .5	+ .1	40 33 45.28	+2 37.01	+ 23	— 6	+ 5	6	40 36 22.57	9.0
	9		20.1203	14.6297	—127	— .2	— .3	40 38 41.37	—2 18.41	— 20	— 7	— 4	7	22.72	9.0
	10		9.7563 II	31.0520 IV	+ 3	+1.4	+ .5	40 27 23.12	+8 58.10	+ 79	+ 29	+20	9	22.59	8.6
	II 1	R	22.1157	15.6620	— 63	+2.0	+2.6	40 39 5.52	—2 42.91	— 24	+ 65	— 5	6	23.03	5.7
	2		17.3870	22.5543	— 1	+ .5	+ .4	40 38 32.91	—2 10.56	— 19	+ 13	— 3	6	22.32	
	3		18.6813	21.1650	— 2	+1.1	+ .6	40 35 19.85	+1 2.75	+ 9	+ 25	+ 2	6	23.02	4.8
	4		19.6900	21.7287	+ 12	.0	—1.0	40 37 14.86	— 51.54	— 8	— 13	— 2	7	23.16	
	5		19.8770	19.5920	— 2	+1.4	+ .2	40 36 29.51	— 7.20	— 1	+ 25	— 0	9	22.64	
	6		10.1007 II	32.8920 IV	+ 37	— .8	+ .5	40 46 0.45	—9 35.97	— 84	— 6	—17	6	23.47	
	7		26.6740	15.0877	+ 90	+ .2	+ .2	40 41 16.68	—4 52.99	— 43	+ 5	— 8	6	23.29	5.6
	8		32.1777	11.2163	+ 14	+ .2	+3.4	40 27 32.61	+8 49.68	+ 77	+ 47	+17	8	23.78	
Feb. 26	10		27.9983 IV	11.8680 II	+ 2	—3.4	—2.3	40 29 35.81	+6 47.58	+ 59	— 84	+11	7	23.32	5.6
	II 1	D	16.1750	22.5933	— 35	— .1	+ .8	40 39 5.67	—2 42.09	— 24	+ 9	— 5	6	23.44	18.5
	2		22.2737	17.1343	— 13	+2.4	+ .9	40 38 33.04	—2 9.83	— 19	+ 50	— 3	6	23.55	
	3		21.2810	18.7693	+ 1	—1.1	—1.3	40 35 19.95	+1 3.47	+ 9	— 34	+ 2	6	23.25	19.8
	4		20.4710	18.4177	— 10	—2.7	—2.3	40 37 14.95	— 51.86	— 8	— 73	— 2	7	23.33	19.3
	5		19.1880	19.4003	0	—1.9	—2.3	40 36 29.56	— 5.36	— 1	— 60	— 0	9	23.68	
	6		32.4810 IV	9.6937 II	+ 27	+ .1	— .8	40 46 0.52	—9 35.85	— 88	— 9	—17	6	23.59	18.1
	7		13.1353	24.7290	—106	— .5	.0	40 41 16.72	—4 52.68	— 43	— 8	— 8	6	23.51	17.8
	8		9.4977 II	30.4437 IV	0	+ .1	— .2	40 27 32.63	+8 49.26	+ 81	— 1	+17	8	22.94	
Feb. 27	10		12.9470 II	29.0973 IV	— 34	—2.7	—3.9	40 29 35.81	+6 47.99	+ 63	— 93	+11	7	23.68	17.4
	I 1	R	9.9840	25.3170	—313	+1.3	+ .1	40 42 51.07	—6 26.64	— 56	+ 22	—13	8	24.04	35.0
	2		19.5523	23.6423	+ 57	—1.8	—2.0	40 34 39.64	+1 43.61	+ 15	— 54	+ 4	8	22.98	
	3		12.4127	26.7287	— 55	—1.9	— .2	40 42 25.88	—6 1.59	— 53	— 33	—10	6	23.39	
	4		22.0933	18.5230	+ 9	+ .9	— .1	40 37 54 09	—1 30.24	— 13	+ 13	— 3	7	23.89	34.4
	5		25.1000	16.8727	+ 71	— .2	+1.3	40 32 55.07	+3 28.06	+ 30	+ 13	+ 7	7	23.70	
	6		15.7503	22.3553	— 54	+2.1	+2.3	40 33 35.74	+2 46.76	+ 24	+ 63	+ 5	6	23.48	34.2
	7		12.9633	29.1693	+152	—1.3	— .9	40 43 14.66	—6 49.87	— 60	— 32	—12	7	23.82	34.2
	8		16.8280	23.0747	— 4	+ .8	+ .4	40 33 45.45	+2 37.83	+ 23	+ 18	+ 5	6	23.43	33.3*
	9		17.2663	22.7080	+ 2	—2.5	— .7	40 38 41.55	—2 17.50	— 20	— 49	— 4	7	23.39	
Mar. 3	10		30.9857 IV	9.6273 II	+ 8	—1.9	—1.7	40 27 23.30	+8 59.68	+ 83	— 53	+20	9	23.57	32.4
	I 1	D	26.1917	10.8687	—196	—1.7	— .7	40 42 51.23	—6 26.68	— 56	— 36	—13	8	23.58	41.8
	2		22.5623	18.4893	+ 18	— .9	+ .7	40 34 39.83	+1 42.96	+ 15	— 5	+ 4	8	23.01	
	3		27.3787	13.0920	+ 30	—1.0	—1.9	40 42 26.11	—6 1.07	— 53	— 40	—10	6	24.07	
	4		17.9673	21.5317	— 7	—1.7	—2.0	40 37 54.34	—1 30.05	— 13	— 53	— 3	7	23.67	42.2
	5		16.2293	24.4457	— 26	+ .2	— .4	40 32 55.34	+3 27.54	+ 30	— 2	+ 7	7	23.30	
	6		23.5043	16.8787	+ 12	—1.6	— .7	40 33 36.05	+2 47.44	+ 24	— 35	+ 5	6	23.49	41.2
	7		28.2867	12.0503	+ 25	—1.6	—1.2	40 43 14.97	—6 50.32	— 60	— 41	—12	7	23.59	
	8		23.3337	17.0947	+ 12	—2.2	—1.2	40 33 45.82	+2 37.67	+ 23	— 50	+ 5	6	23.33	
	9		22.8400	17.3580	+ 4	— ,0	— .5	40 38 41.93	—2 18.53	— 20	— 6	— 4	7	23.17	40.6
	10		9.3023 II	30.6167 IV	— 1	—1.1	—1.6	40 27 23.65	+8 58.56	+ 83	— 38	+20	9	22.95	40.4
	II 1	R	23.4853	17.1203	+ 18	—2.7	—2.7	40 39 5.90	—2 40.87	— 24	— 77	— 5	6	24.03	33.0
	2		17.3407	22.4360	— 5	—1.0	—2.1	40 38 33.26	—2 8.73	— 19	— 43	— 3	6	23.94	31.8
	3		18.4700	20.9377	— 7	—1.9	—1.6	40 35 20.09	+1 2.34	+ 9	+ 51	+ 2	6	23.11	
	4		20.7110	22.7747	+ 31	—1.1	—1.6	40 37 15.03	— 52.22	— 8	— 38	— 2	7	22.40	
	5		20.6940	20.4500	+ 1	—2.0	—1.8	40 36 29.59	— 6.17	— 1	— 55	0	9	22.95	
	7		24.4587	12.8843	—133	— .3	— .8	40 41 16.67	—4 52.12	— 43	— 15	— 8	6	23.95	31.4
	8		31.2370 IV	10.2683 II	+ 6	+ .1	+ .2	40 27 32.54	+8 49.84	+ 81	+ 4	+17	8	23.48	
Mar. 4	10		27.6473 IV	11.5350 II	+ 14	—2.2	—2.1	40 29 35.66	+6 47.16	+ 63	— 62	+11	7	23.01	31.5
	I 1	R	13.1730	28.4967	+113	+ .2	— .5	40 42 51.28	—6 27.48	— 56	— 3	—13	8	23.16	42.6
	2		18.0963	22.1630	+ 5	—1.2	— .9	40 34 39.90	+1 42.77	+ 15	— 32	+ 4	8	22.62	
	3		12.1870	26.5373	— 79	+1.2	+ .3	40 42 26.19	—6 2.40	— 53	+ 22	—10	6	23.44	
	4		21.4913	17.8877	— 9	+1.1	— .1	40 37 54.42	—1 31.03	— 13	+ 16	— 3	7	23.46	43.1
	5		24.7823	16.5930	+ 48	.0	+ .9	40 32 55.43	+3 27.05	+ 30	+ 11	+ 7	7	23.03	42.8
	6		16.3543	22.9547	— 21	+2.3	+2.0	40 33 36.15	+2 46.72	+ 24	+ 62	+ 5	6	23.84	

* 20 s. late. Turned in azimuth ; reduction to meridian —″.37.

1897.	Star.	P	Micrometer.		C	Levels. A	Levels. B	$\frac{1}{2}(\delta+\delta')$	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Ther. mom.
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Mar. 4	I 7	R	14.1423	30.3717	+ 319	−2.7	+ .4	40 43 15.08	−6 50.88	— 60	— 38	−12	7	40 36 23.17	
	8		17.7000	23.9150	+ 43	+ .4	+ .8	40 33 45.94	+2 37.15	+ 23	+ 17	5	6	23.60	42.4
	9		16.3290	21.8087	— 45	— .5	— .1	40 38 42.05	−2 18.35	— 20	— 10	− 4	7	23.43	
	10		32.6753 iv	11.3727 ii	+ 23	+ .2	+1.5	40 27 23.78	+8 58.32	+ 83	+ 23	20	9	23.45	41.4
	II 1	D	17.2530	23.6493	+ 26	−1.8	−1.8	40 39 5.96	−2 41.68	— 24	— 52	— 5	6	23.53	35.2
	2		22.1860	17.0473	— 17	−1.4	−1.3	40 38 33.32	−2 9.80	— 19	— 39	— 3	6	22.97	
	3		22.0443	19.5437	16	− .9	− .8	40 35 20.14	+1 3.22	+ 9	— 25	+ 2	6	23.28	
	4		25.5347	23.4763	81	− .4	+ .7	40 37 15.06	— 52.22	— 8	+ 2	— 2	7	22.83	
	5		19.6663	19.9250	— 1	+ .5	— .2	40 36 29.61	— 6.54	— 1	+ 5	0	9	23.20	
	6		32.0417 iv	9.2307 ii	+ 15	1.0	+ 1.2	40 46 0.57	−9 36.42	— 88	+ 31	−17	6	23.47	
	7		14.4090	26.0093	+ 17	−1.3	−1.2	40 41 16.68	−4 53.15	— 43	— 36	— 8	6	22.72	
	8		10.3220 ii	31.3090 iv	+ 5	− .6	− .1	40 27 32.53	+8 50.30	81	— 11	+ 17	8	23.78	34.4
Mar.	10		13.4640 ii	29.6180 iv	— 51	−3.1	−4.2	40 29 35.64	+6 48.04	+ 63	—1.03	+ 11	7	23.46	34.8
7	I 1	D	27.2583	11.9153	— 55	+ .3	1.2	40 42 51.40	−6 27.54	— 56	— 10	−13	8	23.15	48.7
	2		22.8897	18.7977	+ 30	−1.1	−3.1	40 34 40.05	+1 43.47	+ 15	— 57	+ 4	8	23.22	
	3		27.7603	13.4370	+ 75	.0	— .3	40 42 26.35	−6 2.10	— 53	— 4	−10	6	23.64	
	4		17.7070	21.2863	+ 16	.0	−1.4	40 37 54.62	−1 30.40	— 13	— 18	— 3	7	23.95	48.0
	5		15.6190	23.8547	— 20	— .6	— .3	40 32 55.66	+3 28.05	+ 30	— 13	+ 7	7	24.02	
	6		23.3730	16.7770	+ 4	+ .8	+ .3	40 33 36.41	+2 46.68	+ 24	+ 17	+ 5	6	23.61	
	7		28 5187	12.2763	+ 56	−1.7	— .9	40 43 15.36	−6 50 55	— 60	— 38	−12	7	23.78	
	8		23.3743	17.1300	+ 14	−2.5	−1.8	40 33 46.27	+ 2 37.81	+ 23	— 63	5	6	23.79	47.3
	9		22.9567	17.4810	+ 10	−2.1	−2.3	40 38 42.40	−2 18.38	— 20	— 63	— 4	7	23.22	
Mar.	10		9.6600 ii	30.9450 iv	+ 3	+ .3	+ .2	40 27 24.12	+8 57.83	+ 83	+ 7	+ 20	9	23.14	46.4
8	I 1	R	13.3980	28.7070	+ 140	−1.6	−1.8	40 42 51.40	−6 27.18	— 56	— 48	−13	8	23.13	44.1
	2		19.2647	23.3577	+ 47	−2.7	−2.5	40 34 40.06	+1 43.54	+ 15	— 75	4	8	23.12	43.4
	3		12.0620	26.3947	— 96	— .3	−1.2	40 42 26.38	−6 1.91	— 53	— 21	−10	6	23.69	
	5		24.3350	16.1427	+ 18	+ .2	+ .5	40 32 55.70	+3 27.05	+ 30	+ 10	+ 7	7	23.29	43.0
	6		17.0317	23.6003	+ 20	− .1	+ .5	40 33 36.47	+2 46.02	+ 24	+ 5	+ 5	6	22.89	
	8		19.9047	26.0780	+ 171	− .2	.0	40 33 46.34	+2 36.39	+ 23	— 3	+ 5	6	23.04	41.7
	10		31.1900 iv	9.9017 ii	+ 5	1.0	+ .1	40 27 24.20	+ 8 57.92	83	— 14	+ 20	9	23.10	
	II 1	R	23.1260	16.6830	— 5	— .8	— .9	40 39 6.45	−2 42.79	— 24	— 25	− 5	6	23.18	36.7
	2		18.3410	23.4847	+ 41	−1.9	−2.1	40 38 33.78	−2 10.07	— 19	— 57	— 3	6	22.98	
Mar.	3		19.2300	21.7207	+ 10	+ .2	— .6	40 35 20.54	+1 2.96	+ 9	— 10	+ 2	6	23.57	36.6
12	I 1	D	27.3263	11.9827	— 45	+ .4	.0	40 42 51.29	−6 27.58	— 56	+ 6	13	8	23.16	46.4
	2		22.1663	18.0783	+ 2	— .6	−2.2	40 34 40.00	+1 43.30	+ 15	— 38	+ 4	8	23.19	
	3		27.5810	13.2363	+ 53	+ 1.6	+ 1.0	40 42 26.34	−6 2.59	— 53	+ 39	−10	6	23.57	
	4		16.8717	20.4793	— 41	+ .5	— .4	40 37 54.65	−1 31.05	— 13	+ 3	— 3	7	23.54	45.1
	5		15.5393	23.7237	— 25	+ 1.5	+ .5	40 32 55.73	+3 26.74	+ 30	+ 31	+ 7	7	23.22	44.4
	6		23.3553	16.7413	+ 3	−1.5	− .9	40 33 36.53	+2 47.13	+ 24	— 35	+ 5	6	23.66	
	7		28.6633	12.3950	+ 75	— .6	+ .3	40 43 15.51	−6 51.25	— 60	— 5	−12	7	23.56	43.8
	8		23.2530	17.0620	+ 9	− .5	— .4	40 33 46.51	+2 36.45	+ 23	— 13	+ 5	6	23.17	
	9		23.4223	17.9027	+ 33	.8	.0	40 38 42.66	−2 19.55	— 20	+ 13	— 4	7	23.07	
Mar.	10		9.0313 ii	30.3100 iv	— 3	.6	+ 1.6	40 27 24.39	+8 57.65	+ 83	+ 30	+ 20	9	23.46	42.6
13	II 6	R	8.8807 ii	31.7110 iv	+ 7	.8	.1	40 46 1.37	9 36.89	— 88	— 14	−17	6	23.35	
	7		25.9220	14.2980	+ 10	.6	.7	40 41 17.34	−4 53.74	— 43	— 18	— 8	6	22.97	
	8		32.0060 iv	11.0540 ii	+ 12	— .3	— .8	40 27 33.07	+8 49.44	+ 81	— 15	+ 17	8	23.42	42.2
	9		22.7030	19.1597	+ 29	— .1	1.5	40 34 53.73	+1 29.60	+ 13	— 21	+ 3	6	23.34	41.5
Mar.	10		27.6543	11.5673	+ 14	— .7	— .9	40 29 36.12	+6 46.52	+ 63	— 22	+ 11	7	23.23	
14	I 1	R	13.0573	28.3773	+ 97	— .2	−1.2	40 42 51.25	−6 27.34	— 56	— 18	−13	8	23.12	42.7
	2		18.7307	22.8137	+ 26	−1.3	−1.9	40 34 39.99	+1 43.23	+ 15	— 45	4	8	23.04	
	3		12.8477	27.1957	+ 3	+ .3	+ .3	40 42 26.34	−6 2.55	— 53	+ 10	−10	6	23.32	
	4		22.6177	19.0087	+ 26	+ 1.1	+ 1.2	40 37 54.66	−1 31.26	— 13	+ 33	— 3	7	23.64	42.1
	5		24.7870	16.6140	+ 49	— .3	+ .7	40 32 55.75	+3 26.64	+ 30	+ 4	+ 7	7	22.87	
	6		17.1053	23.6670	+ 23	+1.3	1.3	40 33 36.58	+2 45.86	+ 24	+ 37	+ 5	6	23.16	
	7		13.2737	29.5447	+ 196	+ .7	+ 1.5	40 43 15.55	−6 51.62	— 60	+ 30	−12	7	23.58	41.2

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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Mar. 14	I 8	R	17.9483	24.1393	+ 57	— .6	— .2	40 33 46.58	+2 36.58	+ 23	— 12	+ 5	6	40 36 23.38	
	9		17.4697	22.9923	+ 10	+ .2	+ .1	40 38 42.74	—2 19.57	— 20	+ 4	— 4	7	23.04	
	10		32.2447iv	10.9657 II	+ 18	— .1	+ .6	40 27 24.47	+8 57.71	+ 83	+ 6	+20	9	23.36	40.6
	II 1	D	16.1143	22.5567	— 37	-1.4	—3.2	40 39 7.19	—2 42.69	— 24	— 63	— 5	6	23 64	31.8
	2		23.1517	17.9513	+ 26	+ .7	— .2	40 38 34.50	—2 11.47	— 19	+ 8	— 3	6	22.95	
	3		20.9760	18.5267	— 6	—1.3	— .2	40 35 21.51	+1 1.87	+ 9	— 23	+ 2	6	23.32	
	4		20.2793	18.1707	— 14	+ .7	— .2	40 37 15.98	— 53.24	— 8	+ 8	— 2	7	22.79	31.8
	5		19.7080	20.0140	— 1	+1.4	+1.2	40 36 30.41	— 7.73	— 1	+ 38	— 0	9	23.14	
	6		31.2250iv	8.3673 II	— 5	+1.9	+1.1	40 46 1.44	—9 37.55	— 88	+ 44	—17	6	23.34	31.5
	7		14.8403	26.4743	+ 69	—1.0	— .9	40 41 17.40	—4 54.14	— 43	— 27	— 8	6	22.54	
	8		8.0649 II	29.0070iv	— 12	+ .6	+1.3	40 27 33.12	+8 49.13	+ 81	26	17	8	23.57	
	9		17.8033	21.3407	— 11	+ .6	+ .1	40 34 53.78	+1 29.35	+ 13	+ 11	+ 3	6	23.46	
Mar. 16	10		12.0830 II	28.1620iv	+ 17	+1.2	— .3	40 29 36.17	+6 46.32	63	15	11	7	23.45	31.4
	I 3	D	28.0587	13.7120	+110	0	— .1	40 42 26.39	—6 2.78	— 53	— 2	—10	6	23.02	51.4
	4		16.9347	20.5867	— 39	+1.2	+1.8	40 37 54.73	—1 32.18	— 13	+ 42	— 3	7	22.88	50.6
	5		16.9163	24.5183	+ 48	+1.7	+1.5	40 32 55.83	+3 27.37	+ 30	+ 46	+ 7	7	24.10	
	6		23.6873	17.1217	+ 25	+ .1	+ .1	40 33 36.67	+2 45.96	24	3	5	6	23.01	
	7		28.1300	11.8323	— 8	— .2	+4.1	40 43 15.65	—6 51.80	— 60	+ 50	—12	7	23.70	50.4c
	8		23.1417	16.9983	+ 4	+1.3	+1.1	40 33 46.71	+2 35.24	+ 23	+ 35	+ 5	6	22.64	
	9		23.1937	17.6530	+ 20	+1.2	+1.3	40 38 42.88	—2 20.05	— 20	+ 35	— 4	7	23.01	
	10		8.7160 II	29.9680iv	— 8	0	+ .5	40 27 24.59	+8 56.97	+ 83	+ 7	+ 20	9	22.75	50.0
	II 1	R	24.6417	18.2297	+ 81	—5.0	—6.0	40 39 7.38	—2 42.22	— 24	—1.57	— 5	6	23.36	39.2
	2		17.4323	22.5893	0	—1.8	—1.8	40 38 34.70	—2 10.31	— 19	— 52	— 3	6	23.71	
	3		18.8627	21.2823	+ 2	+ .5	+ .6	40 35 21.36	+1 1.14	+ 9	+ 15	+ 2	6	22.82	40.
	4		19.3127	21.4197	+ 6	+ .3	+ .1	40 37 16.12	— 53.25	— 8	+ 7	— 2	7	22.91	
	5		20.6257	20.3453	+ 1	—1.7	—1.9	40 36 30.52	— 7.09	— 1	— 51	— 0	9	23.00	
	6		7.8610 II	30.7110iv	— 17	—1.3	—1.6	40 46 1.56	—9 37 32	— 92	— 41	—17	6	22.80	
	7		25.1797	13.5477	— 64	— .9	— 7	40 41 17.51	—4 53.75	— 43	— 23	— 8	6	23.08	39.6
	8		29.1447iv	8.2067 II	— 11	+ .3	0	40 27 33.19	+8 49.03	85	+ 5	+ 17	8	23.37	
	9		23.5340	19.9957	+ 55	— .5	+ .3	40 34 53.86	+1 29.54	+ 13	— 4	3	6	23.58	
Mar. 17	10		28.8920iv	12.8117 II	— 30	— .5	—1.9	40 29 36.24	+6 46.23	+ 67	— 33	+ 12	7	23.00	38.9
	I 3	R	12.8450	27.1837	+ 8	— .7	+ .1	40 42 26.44	—6 2.33	— 53	— 9	—10	6	23.45	52.7
	4		22.3157	18.7087	+ 16	—1.2	— .2	40 37 54.78	—1 31.18	— 13	— 21	— 3	7	23.30	
	5		23.0040	14.7873	— 79	—1.7	— .2	40 32 55.89	+3 27.42	+ 30	— 30	7	7	23.45	
	6		17.2253	23.8267	+ 31	—2.7	—2.0	40 33 36.74	+2 46.89	+ 24	— 68	5	6	23.30	51.4
	7		12.1883	28.4677	+ 48	+ .3	— .9	40 43 15.72	—6 51.46	— 60	— 7	—12	7	23.54	51.4]
	8		17.0213	23.2087	+ 6	— .3	— .5	40 33 46.80	+2 36.36	23	— 12	+ 5	6	23.38	
	9		17.5577	23.0807	+ 2	— .7	—1.5	40 38 42.97	—2 19.56	— 20	— 31	— 4	7	22.93	
	10		31.3827iv	10.1000 II	+ 9	—1.6	— .6	40 27 24.79	+8 57.79	92	— 33	+ 20	9	23.46	50.2
	II 1	D	17.0610	23.5513	+ 18	— .1	+ .3	40 39 7.49	—2 44.04	— 24	+ 2	— 5	6	23.24	40.8
	2		22.2950	17.1033	— 13	.0	—1.2	40 38 34.80	—2 11.15	— 19	— 15	— 3	6	23.34	
Mar.	3		21.6007	19.1277	+ 8	—2.0	—1.1	40 35 21.47	+1 2.51	+ 9	— 46	+ 2	6	23.69	41.2d
18	I 3	R	12.5027	26.8743	— 40	+1.3	+ .8	40 42 26.48	—6 3.03	— 53	+ 31	—10	6	23.19	58.3a
	4		22.9040	19.2667	+ 34	+1.0	.0	40 37 54.83	—1 31.99	— 13	+ 16	— 3	7	22.91	
	5		23.4573	15.2570	— 46	.0	.0	40 32 55.95	+3 27.09	+ 30	0	+ 7	7	23.48	58.
	6		16.7113	23.2780	— 1	— .3	+ 1.0	40 33 36.81	+2 45.92	+ 24	+ 8	+ 5	6	23.16	
	7		11.6183	27.9270	— 33	+ 1.7	+ 1.6	40 43 15.80	—6 52.00	— 60	+ 48	—12	7	23.63	56.9
	8		17.3870	23.5400	+ 26	+ 2.5	+ 1.6	40 33 46.89	+2 35.54	+ 23	+ 60	+ 5	6	23.37	56.2
	9		17.7930	23.3277	+ 27	+ .4	+ 1.7	40 38 43.06	—2 19.92	— 20	+ 28	— 4	7	23.25	
	10		30.7977iv	9.5630 II	+ 1	+ 1.7	+ 2.1	40 27 24.78	+8 56.55	+ 92	+ 54	+ 20	9	23.08	56.6
Mar. 19	II 1	R	24.9827	18.5033	+ 98	—1.1	—1.0	40 39 7.78	—2 43.97	— 23	— 31	— 5	6	23.28	46.9
	2		17.7423	22.9773	+ 15	+ 2.2	+ 2.0	40 38 35.08	—2 12.31	— 19	+ 60	— 3	6	23.21	
	3		18.5947	21.0397	— 4	+ 1.7	+ .9	40 35 21.72	+1 1.77	+ 8	+ 39	+ 2	6	24.04	44.9
	4		20.8263	18.6863	— 5	— .3	+ .1	40 37 16.42	— 54.06	— 8	— 3	— 2	7	22.30	
	5		19.1287	19.4450	— 1	+ 1.1	+ .1	40 36 30.78	— 7.99	— 2	+ 19	0	9	23.05	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Mar.								° ′ ″						° ′ ″	°
19	II 6	R	30.7133iv	7.8133 II	18	.1	— .1	40 46 1.85	—9 38.58	— 92	+ 16	—17	6	40 36 22.40	45.6
	7		13.6557	25.2887	53	—1.6	—1.4	40 41 18.16	—4 53.80	— 41	— 44	— 8	6	23.49	
	8		8.3613 II	29.3097iv	— 10	— .8	— .1	40 27 33.38	+8 49.29	+ 84	— 14	+17	8	23.62	
Apl.	10		11.3377 II	27.3593iv	23	+1.3	+ .1	40 29 36.42	+6 44.89	+ 67	+ 22	+12	7	[22.39]	45.4d
6	II 1	D	17.0257	23.6460	21	— .1	— .7	40 39 11.30	—2 47.33	— 23	— 10	— 5	6	23.65	35.9
Apl.	2		24.4007	19.0670	82	+3.3	+ .7	40 38 38.60	—2 14.98	— 19	+ 62	— 3	6	[24.08]	c
9	II 1		17.3743	24.0197	40	—1.3	—1.0	40 39 11.95	—2 48.01	— 23	— 34	— 5	6	23.38	37.
	2		23.6810	18.3187	47	+1.3	+1.5	40 38 39.26	—2 15.61	— 19	+ 42	— 3	6	23.91	
	3		21.2437	18.9810	3	—1.6	—1.4	40 35 24.77	+ 57.18	+ 8	— 43	+ 2	6	[21.68]	36.7
	4		21.2707	18.9983	4	— .9	—2.0	40 37 20.12	— 57.43	— 8	— 40	— 2	7	22.26	
	5		19.8137	20.2530	0	— .4	— .9	40 36 34.23	— 11.10	— 2	— 18	0	9	23.02	
	6		32.2450iv	9.2270 II	19	+1.4	+ .4	40 46 5.65	—9 41.66	— 92	+ 27	—17	6	23.23	36.6
	7		14.6820	26.5080	61	— .2	+ .8	40 41 21.35	—4 58.97	— 41	+ 7	— 8	6	22.02	
	8		8.6510 II	29.4203iv	— 7	+2.2	+2.8	40 27 36.60	+8 44.77	+ 84	+ 71	+17	8	23.17	
	9		18.1540	21.5463	— 4	—1.6	—2.0	40 34 57.39	+1 25.71	+ 11	— 51	+ 3	6	22.79	
Apl.	10		12.7983 II	28.7287iv	— 27	+1.2	+ .7	40 29 39.75	+6 42.45	+ 67	+ 28	+12	7	23.34	36.1
13	II 1	R	23.8887	17.2000	32	+1.0	+ .8	40 39 12.69	—2 49.09	— 23	+ 26	— 5	6	23.64	42.1
	2		17.8200	23.2037	24	.0	— .2	40 38 40.01	—2 16.09	— 19	— 2	— 3	6	23.74	41.9
	3		20.4647	22.6927	30	+1.3	+ .6	40 35 26.51	+ 56.37	+ 8	+ 28	+ 2	6	23.32	40.2
	4		20.5203	22.7890	32	— .5	—1.5	40 37 20.80	— 57.41	— 8	— 27	— 2	7	23.09	
	5		21.2203	20.7523	4	+ .5	— .2	40 36 34.88	— 11.84	— 2	+ 6	— 0	9	23.17	
	6		8.8127 II	31.8287iv	8	—2.0	— .9	40 46 6.38	—9 41.58	— 92	— 43	—17	6	23.34	
	7		26.4750	14.7010	61	—1.0	—2.0	40 41 22.06	—4 57.65	— 41	— 41	— 8	6	23.57	40.8
	8		31.7503iv	10.9600 II	9	—1.3	— .4	40 27 37.21	+8 45.34	+ 84	— 26	+17	8	23.38	
	9		23.0857	19.6927	41	—2.3	—2.0	40 34 58.07	+1 25.84	+ 11	— 62	+ 3	6	23.49	
Apl.	10		28.3920iv	12.4817 II	— 16	— .7	.0	40 29 40.44	+6 41,98	+ 67	— 11	+11	7	23.16	40.0
14	II 1	D	16.2990	22.9970	— 22	— .2	.0	40 39 12.89	—2 49.19	— 23	— 3	— 5	6	23.45	43.3
	2		22.6800	17.2853	— 0	—1.3	—2.0	40 38 40.22	—2 16.31	— 19	— 46	— 3	6	23.29	
	3		20.1590	17.9130	— 18	—2.3	—1.9	40 35 26.72	+ 56.71	+ 8	— 61	+ 2	6	22.98	43.4
	4		20.4247	18.1323	— 13	—1.0	— .5	40 37 20.98	— 57.89	— 8	— 22	— 2	7	22.84	42.8
	5		18.4033	18.8663	— 6	—1.4	— .9	40 36 35.04	— 11.68	— 2	— 34	0	9	23.09	43.4
	6		29.8033iv	6.8037 II	— 44	— .2	—2.0	40 46 6.57	—9 41.03	— 92	— 28	—17	6	24.23	
	7		13.4940	25.3260	— 70	—1.9	—1.0	40 41 22.24	— 4 58.81	— 41	— 43	— 8	6	22.57	42.9
	8		8.1900 II	28.9643iv	— 9	—1.5	— .9	40 27 37.38	+8 44.89	+ 84	— 35	+17	8	23.01	
	9		16.9380	20.3047	— 41	+1.4	+1.2	40 34 58.25	+1 24.96	+ 11	+ 38	+ 3	6	23.79	
Apl.	10		11.9267 II	27.8267iv	+ 5	— .6	+ .1	40 29 40.62	+6 41.77	+ 67	— 8	+11	7	23.16	42.4
15	II 1	R	22.7383	16.0067	37	— .1	+ .1	40 39 13.13	—2 50.00	— 23	— 0	— 5	6	22.91	46.7
	2		17.4240	22.8357	— 5	— .2	— 9	40 38 40.44	—2 16.73	— 19	— 14	— 3	6	23.41	45.3
	3		18.5767	20.7847	— 6	+1.6	+ .4	40 35 26.93	+ 55.78	+ 8	+ 30	+ 2	6	23.17	
	4		18.1947	20.5027	— 12	—1.4	— .8	40 37 21.08	— 58.29	— 8	— 33	— 2	7	22.43	
	5		22.2370	21.7820	8	—2.3	—2.2	40 36 35.23	— 11.52	— 2	— 65	— 0	9	23.13	
	6		9.0410 II	32.0737iv	15	— .9	— .6	40 46 6.78	—9 42.02	— 92	— 22	—17	6	23.51	45.3*
	7		26.4163	14.6070	52	— .6	—1.7	40 41 22.45	—4 58.52	— 41	— 31	— 8	6	23.19	45.1
	8		32.0403iv	11.2750 II	10	—2.0	—2.0	40 27 37.57	+8 44.71	+ 84	— 57	+17	8	22.80	45.5
	9		22.0397	19.6700	17	—2.3	—2.0	40 34 58.44	+1 25.19	+ 11	— 62	+ 3	6	23.21	
Apl.	10		27.1493iv	11.2710 II	28	+1.1	+1.0	40 29 40.82	+6 41.28	+ 54	+ 30	+11	7	23.12	44.6
16	II 1	D	17.3667	24.1070	43	+2.1	+2.0	40 39 13.37	—2 50.42	— 23	+ 59	— 5	6	23.32	51.3
Apl.	3		21.0187	18.7927	— 3	—1.7	—1.6	40 35 27.17	+ 56.24	+ 8	— 47	+ 2	6	23.10	
22	II 1	D	16.1913	22.9783	— 25	+ .4	— .4	40 39 14.91	—2 51.43	— 23	+ 1	— 5	6	23.27	48.5
	2		22.0627	16.5613	— 35	+1.4	+ .6	40 38 42.27	—2 18.92	— 19	+ 30	— 3	6	23.49	
	3		21.3607	19.2300	+ 6	+ .6	+ .3	40 35 28.75	+ 53.85	+ 8	+ 13	+ 2	6	22.89	48.2
	4		21.0953	18.7180	— 3	— .3	— .4	40 37 22.89	—1 0.06	— 8	— 10	— 2	7	22.70	47.8
	5		19.1037	19.6577	— 2	+ .2	+ .1	40 36 36.88	— 13.99	— 2	+ 4	0	9	23.00	
	6		32.5337iv	9.4347 II	+ 26	+ .1	— .1	40 46 8.60	—9 43.72	— 79	— 0	—17	6	23.98	
	7		14.0163	25.9127	— 3	— .9	— .7	40 41 24.24	—5 0.59	— 41	— 24	— 8	6	22.98	47.8

* Light poor.

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Ther. mom.
Apl.								° ′ ″						° ′ ″	°
22	II 8	D	7.8953 II	28.6263 IV	— 10	— .9	— .8	40 27 39.18	+8 43.80	+ 84	— 25	+17	8	40 36 23.82	
	9		17.6487	20.9367	— 21	— .3	—1.2	40 35 0.18	+1 23.03	+ 11	— 20	+ 3	6	23.21	
Apl.	10		12.1780 II	28.0073 IV	— 4	— .8	— .6	40 29 42.58	+6 39.96	+ 67	— 20	+12	7	23.20	47.4
24	II 1	R	22.3197	15.4890	— 66	+ .9	+ .2	40 39 15.34	—2 52.43	— 23	+ 17	— 5	6	22.86	48.0
	2		18.6303	24.1213	+ 66	—1.8	—1.7	40 38 42.72	—2 18.91	— 19	— 51	— 3	6	23.14	
	3		18.8923	21.0030	+ 1	+1.2	+1.4	40 35 29.22	+ 53.33	+ 8	+ 37	+ 2	6	23.08	47.6
	4		19.5477	21.9553	+ 14	+ .7	+1.2	40 37 23.32	—1 0.87	— 8	+ 26	— 2	7	22.68	
	5		20.4947	19.9217	+ 2	+ .3	+ .3	40 36 37.29	— 14.48	— 2	+ 9	— 0	9	22.97	
	6		8.9780 II	32.1273 IV	+ 16	— .6	+ .2	40 46 9.07	—9 44.97	— 92	— 07	—17	6	23.00	
	7		27.7393	15.8523	+180	— .2	— .6	40 41 24.70	—5 0.81	— 41	— 11	— 8	6	23.35	46.9
	8		30.9647 IV	10.2933 II	+ 3	—1.5	.0	40 27 39.64	+8 42.32	+ 84	— 24	+17	8	22.81	
	9		22.9960	19.7480	+ 38	— .8	+ .7	40 35 0.65	+1 22.17	+ 11	— 4	+ 3	6	22.98	
Apl.	10		26.6910 IV	10.8980 II	+ 45	— .3	— .0	40 29 43.05	+6 39.16	+ 67	— 5	+11	7	23.01	47.3
25	II 1	D	17.6377	24.4247	+ 62	—1.1	— .5	40 39 15.55	—2 51.65	— 23	— 24	— 5	6	23.44	51.4
	2		22.7720	17.2567	+ 1	+ .3	.0	40 38 42.98	—2 19.36	— 19	+ 5	— 3	6	23.51	
	3		20.6180	18.5010	— 8	—1.8	—1.2	40 35 29.44	+ 53.47	+ 8	— 44	+ 2	6	22.63	51.0
	4		21.3527	18.9620	+ 4	—1.5	—2.2	40 37 23.51	—1 0.42	— 8	— 52	— 2	7	22.54	
	5		19.9047	20.4987	+ 2	— .7	— .3	40 36 37.48	— 15.01	— 2	— 15	— 0	9	22.39	
	6		32.0287 IV	8.8947 II	+ 12	+ .6	— .7	40 46 9.28	—9 44.57	— 92	0	—17	6	23.68	49.6
	7		13.8960	25.8657	— 12	+1.6	+ .4	40 41 24.93	—5 2.42	— 41	+ 31	— 8	6	22.39	50.1
	8		8.1167 II	28.8037 IV	— 8	+ .8	— .2	40 27 39.83	+8 42.69	+ 84	+ 10	+17	8	23.71	
	9		19.3397	22.5777	+ 27	+2.2	+1.1	40 35 0.86	+1 21.88	+ 11	+ 49	+ 3	6	23.43	
Apl.	10		12.5787 II	28.3727 IV	— 18	+1.2	— .5	40 29 43.28	+6 39.03	+ 67	+ 12	+11	7	23.28	49.6
26	II 1	R	23.1627	16.3257	— 16	+2.7	+2.2	40 39 15.75	—2 52.71	— 23	+ 71	— 5	6	23.53	56.3
	2		17.0677	22.6257	— 5	+ .9	+1.9	40 38 43.14	—2 20.42	— 19	+ 39	— 3	6	22.95	
	3		18.3563	20.4947	— 10	—1.7	— .9	40 35 29.65	+ 54.01	+ 8	— 37	+ 2	6	23.45	56.2
	4		19.3673	21.7727	+ 11	— .7	+ .2	40 37 23.71	—1 0.81	— 8	— 8	— 2	7	22.79	55.9
	5		20.2477	19.6683	0	.0	— .1	40 36 37.67	— 14.64	— 2	— 2	0	9	23.08	
	6		9.0603 II	32.2220 IV	+ 18	— .4	+ .1	40 46 9.49	—9 45.29	— 92	— 5	—17	6	23.12	
	7		26.5730	14.6500	+ 63	— .1	— .7	40 41 25.13	—5 1.42	— 41	— 11	— 8	6	23.17	55.0
	8		31.3597 IV	10.6767 II	+ 6	— .5	.0	40 27 40.02	+8 42.62	+ 84	— 8	+17	8	23.65	
	9		21.8613	18.5927	+ 6	—2.8	—1.4	40 35 1.06	+1 22.60	+ 11	— 63	+ 3	6	23.23	
Apl.	10		28.2007 IV	12.4113 II	— 12	— .5	— .5	40 29 43.48	+6 38.93	+ 67	— 15	+11	7	23.11	54.9
30	II 1	D	16.6610	23.5033	+ 5	+ .1	— .7	40 39 16.68	—2 52.90	— 23	— 7	— 5	6	23.49	55.6
	2		21.4757	15.9133	— 64	—1.1	— .2	40 38 44.00	—2 20.39	— 19	+ 20	— 3	6	23.65	
	3		20.3073	18.2343	— 13	—1.4	—1.0	40 35 30.61	+ 52.35	+ 8	— 36	+ 2	6	22.76	55.4
	4		19.2743	16.8100	— 42	+ .5	— .2	40 37 24.60	—1 2.16	— 8	+ 5	— 2	7	22.46	
	5		20.4890	21.0930	+ 3	—2.0	— .4	40 36 38.52	— 15.27	— 2	— 37	0	9	22.95	55.4
	6		32.2800 IV	9.1050 II	+ 19	+ .8	— .6	40 46 10.45	—9 45.62	— 96	+ 5	—17	6	23.81	55.2
	7		15.3400	27.3027	+137	—1.3	— .0	40 41 26.08	—5 2.61	— 41	— 20	— 9	6	22.83	54.4
	8		10.5163 II	31.1687 IV	+ 4	—2.2	—0.6	40 27 40.87	+8 41.85	+ 88	— 43	+17	8	23.42	
	9		19.3413	22.5773	+ 27	— .8	—1.7	40 35 1.98	+1 21.83	+ 11	— 33	+ 3	6	23.68	
May	10		13.4317 II	29.1860 IV	— 40	.0	— .6	40 29 45.42	+6 37.97	+ 71	— 7	+12	7	[24.22]	54.8*
8	II 1	R	23.3170	16.3957	— 9	— .6	— .3	40 39 18.67	—2 54.86	— 22	— 14	— 5	6	23.46	63.6
	2		17.1610	22.8323	— 0	+ .4	+ .5	40 38 46.13	—2 23.30	— 18	+ 13	— 4	6	22.80	
	3		18.2903	20.2837	— 12	— .2	— .7	40 35 32.70	+ 50.34	+ 6	— 12	+ 2	6	23.06	62.3
	4		19.5590	22.0697	+ 17	—1.9	—1.0	40 37 26.58	—1 3.48	— 8	— 44	— 2	7	22.63	
	5		22.6500	21.9620	+ 15	— .7	— .9	40 36 40.45	— 17.42	— 3	— 22	— 1	9	22.86	60.6
	6		8.4567 II	31.7183 IV	+ 3	— .3	—1.5	40 46 12.61	—9 47.77	— 91	— 24	—17	6	23.58	
	7		26.8697	14.8150	+ 88	—1.3	—1.7	40 41 28.27	—5 4.82	— 38	— 42	— 9	6	22.62	
	8		30.9470 IV	10.3823 II	+ 2	—1.5	— .6	40 27 42.89	+8 39.63	+ 81	— 31	+17	8	23.27	59.2
	9		22.4277	19.2827	+ 23	—1.2	—1.8	40 35 4.16	+1 19.52	+ 9	— 41	+ 3	6	23.45	59.6
	10		27.4007 IV	11.7337 II	+ 17	—2.1	—2.0	40 29 46.66	+6 35.91	+ 66	— 57	+12	7	22.85	59.3
	III 1	R	30.1853	14.5117	+319	+ .3	+1.1	40 43 0.39	—6 36.84	— 49	+ 19	—14	10	23.21	59.4
	2		9.5300 II	33.7297 IV	+ 59	— .6	— .5	40 46 36.22	–10 11.62	— 93	— 16	—23	11	23.39	

*Mistake in micrometer reading.

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
								° ′ ″						° ′ ″	°
May 8	III 3	R	7.4240 ii	32.8270 iv	+ 5	+ 3.4	+ 1.6	40 25 39.75	+10 41.89	+ 96	+ 74	+18	6	40 36 23.58	
	4		8.2260 ii	33.4407 iv	+ 39	— .3	— .8	40 25 45.23	+10 37.21	+ 95	— 15	+19	6	23.49	
	5		26.9493	15.1167	+107	+ .8	.2	40 31 22.94	+ 4 59.25	37	+ 7	+10	7	22.80	59.8
	6		19.0100	22.3030	+ 20	—2.3	— .9	40 37 46.62	— 1 23.26	— 11	— 48	— 3	6	22.80	
	7		21.0007	19.7547	+ 3	+ .2	1.1	40 36 54.43	— 31.49	— 4	— 11	— 1	6	22.84	59.7
	8		17.2300	24.2283	+ 45	+ .6	—1.1	40 33 26.19	+ 2 56.94	+ 21	— 4	+ 5	6	23.41	
May 9	9		14.0110	27.4010	+ 83	—2.4	— .5	40 42 2.44	- 5 38.54	— 43	— 45	—10	6	22.98	60.0
	II 1	D	16.0677	23.0190	— 28	—1.1	— .8	40 39 18.86	— 2 55.57	— 22	— 27	— 5	6	22.81	61.1
	2		21.8637	16.2227	— 48	— .6	—1.4	40 38 46.33	- 2 22.41	— 18	— 27	— 4	6	23.49	
	3		21.3430	19.3777	+ 6	—1.0	— .3	40 35 32.91	+ 49.67	+ 6	— 20	+ 2	6	22.52	60.3
	4		21.2407	18.6897	— 1	— .7	+ .4	40 37 26.77	- 1 4.46	— 8	— 6	- 2	7	22.22	
	5		19.0277	19.7443	— 3	— .3	— .1	40 36 40.64	— 18.10	— 3	— 7	— 1	9	22.52	
	6		31.0970 iv	7.7687 ii	— 17	+ .1	+ .7	40 46 12.83	- 9 49.41	— 91	+ 10	—17	6	22.50	60.3
	7		12.8997	24.9987	—111	.0	+ .9	40 41 28.49	- 5 5.43	— 38	+ 12	- 9	6	22.77	
	8		8.5193 ii	29.0700 iv	— 6	+ .1	— .2	40 27 43.10	+ 8 39.25	+ 81	— 1	+17	8	23.40	
	9		16.9943	20.1293	— 39	— .2	—1.9	40 35 4.38	+ 1 19.12	+ 9	— 27	3	6	23.41	58.8 *a*
	10		11.9263 ii	27.6190 iv	+ 10	—4.3	—4.8	40 29 46.89	+ 6 36.54	+ 66	—1.29	+12	7	22.99	58.8
	III 2	D	31.8513 iv	7.6093 ii	— 11	+1.8	+ .2	40 46 36.42	10 12.51	93	+ 31	—23	11	23.17	55.8
	3		34.0837 iv	8.6847 ii	+ 64	—1.3	— .2	40 25 39.98	+10 41.93	+ 96	— 23	+18	6	22.88	
	4		32.3840 iv	7.1673 ii	— 9	— .9	—1.2	40 25 45.45	+10 37.14	+ 95	— 30	+19	6	23.49	
	5		12.4697	24.3417	—165	— .3	—2.6	40 31 23.15	+ 4 59.56	+ 37	— 38	+10	7	22.87	55.2
	6		21.7573	18.4613	+ 3	—1.0	—2.9	40 37 46.83	— 1 23.29	— 11	— 52	— 3	6	22.94	54.4
	7		18.8593	20.1053	— 6	—1.5	— .2	40 36 54.64	— 31.47	— 4	— 27	— 1	6	22.91	54.4
	8		23.9620	16.9920	— 30	— .0	+ .2	40 33 26.40	+ 2 56.19	+ 21	+ 2	+ 5	6	22.93	
	9		25.8147	12.4163	—104	—1.0	—2.1	40 42 2.64	— 5 38.28	— 43	— 42	—10	6	23.47	52.8
May 10	II 1	R	23.6210	16.6440	+ 8	—1.4	—1.2	40 39 19 05	- 2 56.31	— 22	+ 37	- 5	6	22.90	55.2
	2		17.3460	23.0210	+ 8	— .1	+ .1	40 38 46.53	— 2 23.41	— 18	0	— 4	6	22.96	
	3		18.9637	20.9280	— 1	+ .7	+ .2	40 35 33.12	+ 49.63	+ 6	+ 13	+ 2	6	23.02	
	4		20.3460	22.8757	+ 35	— .9	— .2	40 37 26.97	— 1 4.01	— 8	— 14	— 2	7	22.79	
	5		20.8237	20.0850	+ 3	+1.6	.0	40 36 40.82	— 18.67	— 3	+ 25	— 1	9	22.45	
	7		25.4527	13.3513	— 73	+2.9	+1.6	40 41 28.72	— 5 5.59	— 38	+ 66	— 9	6	23.38	55.3
	8		31.1447 iv	10.5677 ii	+ 4	—1.7	— .6	40 27 43.30	+ 8 39.94	+ 81	— 34	+17	8	23.96	54.4
	9		22.1440	19.0487	+ 16	— .4	+ .6	40 35 4.61	+ 1 18.25	+ 9	+ 1	+ 3	6	23.05	*a*
	10		28.0230 iv	12.4063 ii	— 9	+ .8	+ .3	40 29 47.12	+ 6 34.57	+ 66	— 8	+12	7	22.46	55.0
	III 1	R	27.7770	12.0727	— 8	—2.4	.0	40 43 0.79	— 6 36.79	— 49	— 38	—14	10	23.09	50.8
	2		8.8860 ii	33.0887 iv	+ 87	—1.9	—1.5	40 46 36.61	—10 11.64	— 93	— 49	—23	11	23.43	52.1 *d*
May 12	3		8.3597 ii	33.7587 iv	+ 51	+1.2	— .3	40 25 40.20	+10 41.90	+ 96	+ 15	+18	6	23.45	*d*
	II 1	D	16.2333	23.2220	— 16	+ .5	+ .2	40 39 19.46	— 2 56.55	— 22	+ 10	— 5	6	22.80	60.9
	2		23.0143	17.3070	— 7	+ .9	+2.1	40 38 46.97	— 2 24.19	— 18	+ 41	— 4	6	23.03	
	3		20.3680	18.4444	— 9	+1.4	+1.7	40 35 33.57	+ 48.58	+ 6	+ 44	+ 2	6	22.73	
	4		21.5167	18.9430	+ 6	— 4	.0	40 37 27.38	— 1 5.05	— 8	— 7	— 2	7	22.23	60.9
	5		19.3997	20.1383	— 1	+ .1	— .1	40 36 41.23	— 18.66	— 3	— 0	— 1	9	22.62	
	6		31.5363 iv	8.2363 ii	— 3	— .4	—1.0	40 46 13.50	— 9 48.73	— 91	— 19	—17	6	23.56	
	7		14.3627	26.4617	+ 39	— .2	+ .5	40 41 29.18	— 5 5.81	— 38	+ 4	— 9	6	23.00	
	8		8.2097 ii	28.7350 iv	— 7	+ .2	—1.0	40 27 43.29	+ 8 38.61	+ 81	+ 16	+17	8	23.12	
	9		17.2607	20.3470	— 32	— .2	— .3	40 35 5.07	+ 1 17.90	+ 9	— 7	+ 3	6	23.08	
	10		11.6847 ii	27.2763 iv	+ 20	+1.0	+ .3	40 29 47.60	+ 6 34.01	+ 66	+ 20	+12	7	22.66	58.6
	III 1	D	11.5583	27.2940	— 80	— .8	— .6	40 43 1.18	— 6 37.40	— 49	— 20	—14	10	23.05	55.0
	2		29.5320 iv	5.2850 ii	—100	— .6	— .2	40 46 36.98	—10 12.42	— 93	— 11	—23	11	23.40	56.9
	3		32.4390 iv	7.0373 ii	— 11	—3.1	—2.3	40 25 40.58	+10 41.81	+ 96	— 78	+18	6	22.81	
	4		31.6543 iv	6.4683 ii	— 42	—1.9	— .8	40 25 46.08	+10 36.28	+ 95	— 40	+19	6	23.16	
	5		12.6827	24.5213	—143	— .8	— .0	40 31 23.73	+ 4 58.77	+ 37	— 12	+10	7	22.92	56.4
	6		22.1813	18.8423	+ 15	+1.6	+ .2	40 37 47.43	— 1 24.41	— 11	+ 28	— 3	6	23.22	
	7		19.6490	20.9423	+ 8	— .5	+ .1	40 36 55.22	— 32.69	— 4	— 7	— 1	6	22.47	
	8		23.9517	17.0007	+ 30	— .9	— .8	40 33 26.97	+ 2 55.71	+ 21	— 24	+ 5	6	22.76	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
May								° ′ ″						° ′ ″	°
12	III 9	D	25.6963	12.2587	—120	+1.1	+ .2	40 42 3.18	— 5 39.23	— 43	+ 20	—10	6	40 36 23.68	56.8
13	II 1	R	22.0733	15.0517	— 88	+1.4	+2.5	40 39 19.71	— 2 57.20	— 22	+ 54	— 5	6	22.84	62.6
	2		16.2707	21.9787	— 45	+ .8	+2.6	40 38 47.21	— 2 24.11	— 18	+ 46	— 4	6	23.40	
	3		19.9447	21.8603	+ 15	+2.7	+1.6	40 35 33.81	+ 48.44	+ 6	+ 63	+ 2	6	23.02	62.6
	4		19.9503	22.5793	+ 30	+ .8	+2.0	40 37 27.61	— 1 6.50	— 8	+ 37	— 2	7	[21.45]	62.5*d*
May	5		21.7293	20.9953	+ 9	— .6	— .5	40 36 41.45	— 18.57	— 3	— 16	— 1	9	22.77	62.4*a*
26	II 1	R	23.0963	16.0077	— 28	— .7	— .6	40 39 22.61	— 2 59.04	— 22	— 18	— 5	6	23.18	60.2
	2		17.0517	22.8563	+ 2	— .8	—1.1	40 38 50.23	— 2 26.67	— 18	— 26	— 4	6	23.14	
	3		19.3373	21.1433	+ 3	+ .4	— .2	40 35 36.97	+ 45.64	+ 6	+ 4	+ 2	6	22.79	59.0
	4		19.7093	22.3930	+ 25	— .2	— .2	40 37 30.59	— 1 7.87	— 8	— 5	— 2	7	22.64	
	5		19.4557	18.6127	— 7	— .1	— .8	40 36 44.39	— 21.28	— 3	— 6	— 1	9	23.10	
	6		8.7630 II	32.2570 IV	+ 16	+2.9	+3.1	40 46 17.10	— 9 53.68	— 91	+ 85	—17	6	23.25	
	7		26.8707	14.6253	+ 79	— .1	— .8	40 41 32.87	— 5 9.61	— 38	— 6	— 9	6	22.79	57.6
	8		29.9290 IV	9.5380 II	+ 2	— .7	— .3	40 27 47.12	+ 8 35.24	+ 81	— 15	+17	8	23.27	
	9		22.4120	19.4543	+ 24	—2.2	— .5	40 35 8.79	+ 1 14.79	+ 9	— 41	+ 3	6	23.35	57.6
	10		28.5067 IV	13.0313 II	— 30	—1.1	—2.5	40 29 51.45	+ 6 30.95	+ 66	— 49	+12	7	22.76	56.8
	III 1	R	30.0383	14.1933	+ 292	— .3	— .3	40 43 4.68	— 6 41.10	— 49	— 9	—14	10	22.96	55.1
	2		9.2137 II	33.5783 IV	+ 54	— .3	— .8	40 46 40.36	—10 15.77	— 93	— 15	—23	11	23.39	
	3		8.9077 II	34.0973 IV	+ 69	+2.7	+1.8	40 25 44.48	+10 36.66	+ 96	+ 65	+18	6	22.99	
	4		8.3470 II	33.3603 IV	+ 37	— .4	+1.2	40 25 49.85	+10 32.12	+ 95	+ 9	+19	6	23.26	55.7
	5		23 9537	12.2640	—193	— .4	— .1	40 31 27.26	+ 4 54.88	+ 37	— 8	+10	7	22.60	
	6		16.6870	20.1787	— 48	—1.0	— .6	40 37 51.06	— 1 28.11	— 11	— 23	— 3	6	22.64	55.1
	7		21.0780	19.6387	+ 4	+1.2	+ .3	40 36 58.77	— 36.38	— 4	+ 23	— 1	6	22.63	
	8		17.1490	23.9230	+ 32	+ .2	+ .3	40 33 30.49	+ 2 51.24	+ 21	+ 7	+ 5	6	22.12	
	9		13.5987	27.1550	+ 44	—1.4	— .4	40 42 6.57	— 5 42.65	— 43	— 27	—10	6	23.18	54.8
May															
27	II 1	D	16.9637	23.9600	+ 29	— .6	— .4	40 39 22.84	— 2 59.38	— 22	— 15	— 5	6	23.10	63.6
	2		21.9660	16.1270	— 49	+ .3	+ .2	40 38 50.47	— 2 27.41	— 18	+ 7	— 4	6	22.97	
	3		21.6173	19.8260	— 11	+ .8	+ .4	40 35 37.22	+ 45.29	+ 6	+ 17	+ 2	6	22.82	
	4		20.7663	18.0570	— 13	— .2	— .4	40 37 30.82	— 1 8.42	— 8	— 8	— 2	7	22.29	62.4
	5		18.7890	19.6513	— .6	—1.0	—1.5	40 36 44.61	— 21.77	— 8	— 35	— 1	9	22.54	
	6		31.7940 IV	8.3233 II	+ 1	+ .1	— .2	40 46 17.35	— 9 53.05	— 91	— 1	—17	6	23.27	61.9
	9		17.5290	20.4600	— 24	+ .8	+ .4	40 35 9.05	+ 1 14.00	+ 9	+ 17	+ 3	6	23.40	62.0
	10		12.4897 II	27.9343 IV	— 9	+ .5	.0	40 29 51.72	+ 6 30.23	+ 66	+ 8	+12	7	22.88	62.0
	III 1	D	9.5366	25.4360	—347	— .7	—1.8	40 43 4.92	— 6 40.86	— 49	— 34	—14	10	23.19	57.3
	2		31.8560 IV	7.4890 II	— 11	—1.4	—1.8	40 46 40.59	—10 15.67	— 93	— 46	—23	11	23.41	
	3		33.4213 IV	8.2193 II	+ 38	—1.8	— .7	40 25 44.75	+10 36.89	+ 96	— 37	+18	6	22.47	
	4		31.2313 IV	6.1647 II	— 58	—2.0	—2.4	40 25 50.11	+10 33.23	+ 95	— 62	+19	6	23.92	
	5		13.6460	25.3343	— 52	— .3	— .7	40 31 27.41	+ 4 55.20	+ 37	— 14	+10	7	23.01	58.4
	6		21.6763	18.2003	— 1	— .6	—1.0	40 37 51.31	— 1 27.83	— 11	— 22	— 3	6	23.18	
	7		19.8600	21.3267	+ 7	+1.5	+1.8	40 36 59.03	— 37.08	— 4	+ 46	— 1	6	22.42	58.4*d*
	8		22.9880	16.1913	— 25	— .3	—1.0	40 33 30.75	+ 2 51.67	+ 21	— 17	+ 5	6	22.57	
June	9		26.3630	12.7950	— 49	+ .1	— .7	40 42 6.80	— 5 42.71	— 43	— 7	—10	6	23.55	58.4
3	II 1	R	23.0497	15.8577	— 25	+ .8	+2.3	40 39 24.36	— 3 1.66	— 22	+ 41	— 5	6	22.90	65.1
	2		16.6540	22.5647	— 21	+1.5	+ .2	40 38 52.07	— 2 29.30	— 18	+ 27	— 4	6	22.88	
	3		18.7577	20.4890	— 5	— .1	.0	40 35 38.92	+ 43.73	+ 6	— 1	+ 2	6	22.78	65.8
	4		18.8330	21.6150	+ 6	+ .4	+1.0	40 37 32.44	— 1 10.31	— 8	+ 19	— 2	7	22.29	65.4
	5		21.0650	20.1250	+ 4	— .7	+ .2	40 36 46.23	— 23.76	— 3	— 9	— 1	9	22.43	
	6		8.6027 II	32.1667 IV	+ 12	+1.2	+1.3	40 46 19.20	— 9 55.44	—1.05	+ 36	—17	6	22.96	
June	7		26.2473	13.9017	+ 8	+ .5	—1.1	40 41 35.06	— 5 11.96	— 38	— 6	— 9	6	22.63	64.6
4	II 1	D	17.2473	24.4070	+ 52	—1.5	—2.0	40 39 24.52	— 3 1.04	— 22	— 49	— 5	6	22.78	63.2
	2		22.9463	17.0513	— 0	—1.3	—2.0	40 38 52.24	— 2 28.95	— 18	— 45	— 4	6	22.68	
	3		20.9063	19.1917	+ 1	— .9	— .8	40 35 39.11	+ 43.33	+ 6	— 24	+ 2	6	22.34	62.8
	4		21.5270	18.7570	+ 4	— .3	+ .4	40 37 32.62	— 1 10.00	— 8	— 0	— 2	7	22.59	
	5		17.9797	18.9100	+ 12	—1.0	—1.5	40 36 46.41	— 23.54	— 3	— 35	— 1	9	22.57	
	6		31.4743 IV	7.9037 II	— 9	— .1	—1.2	40 46 19.41	— 9 55.55	—1.05	— 17	—17	6	22.53	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. t	Corrections. r	Corrections. Mer.	Latitude.	Thermom.
June								° ′ ″						° ′ ″	°
8	II 1	R	22.9380	15.7307	— 43	— .1	.0	40 39 25.24	— 3 2.00	— 23	+ 1	— 5	6	40 36 23.04	62.2
	3		19.2993	21.0010	— 1	— .1	—1.2	40 35 39.82	+ 43.00	— 6	— 16	+ 2	6	22.80	62.6
	4		19.3780	22.1570	+ 18	— .9	—1.8	40 37 33.26	— 1 10.26	— 8	— 37	— 2	7	22.60	
	5		22.5467	21.5957	+ 17	— .6	— .1	40 36 47.05	— 24.07	— 3	+ 8	— 1	9	23.11	
	6		8.0543 iv	31.6293 iv	— 4	—1.4	—1.9	40 46 20.17	— 9 55.67	—1.05	— 46	—17	6	22.88	
	7		26.0217	13.6183	— 19	— .8	— .6	40 41 36.10	— 5 12.60	— 38	— 20	— 9	6	22.89	
	8		30.1650 iv	9.8687 ii	0	—1.7	—2.3	40 27 50.11	+ 8 32.84	+ 95	— 56	+ 17	8	23.59	
June	9		22.1140	19 2817	+ 14	+ .2	+ .8	40 35 12.10	+ 1 11.60	+ 9	+ 13	+ 3	6	24.01	59.4 *a*
9	II 1	D	15.3553	22.5833	— 66	+ .8	+ 2.4	40 39 25.43	— 3 2.47	+ 22	+ 42	— 5	6	23.17	67.2
	2		21.0600	15.1210	— 99	+ .2	+ 1.6	40 38 53.04	— 2 29.81	— 18	+ 23	— 4	6	23.30	
	3		20.5827	18.8997	— 3	— .2	+ .9	40 35 40.01	+ 42.53	+ 6	+ 9	+ 2	6	22.77	66.1
	4		19.8627	17.0223	— 39	+ .6	+ .2	40 37 33.44	— 1 11.67	— 8	+ 12	— 2	7	21.86	
	5		20.5180	21.4927	— 8	— .5	— .2	40 36 47.23	— 24.65	— 3	— 10	— 1	9	22.53	
	6		35.1837 iv	11.5910 ii	+ 106	+ 1.2	+ 1.1	40 46 20.38	— 9 56.40	—1.05	+ 33	—17	6	23.15	65.4
	7		14.5390	26.9147	+ 76	+ .5	+ .7	40 41 36.32	— 5 12.90	— 38	+ 17	— 9	6	23.18	
	8		10.1417 ii	30.3717 iv	+ 1	.0	+ 1.3	40 27 50.32	+ 8 31.17	+ 95	+ 16	+ 17	8	22.85	
June	10		13.3260 ii	28.6243 iv	— 40	+ .2	+ .7	40 29 55.14	+ 6 26.45	+ 80	+ 12	+ 12	6	22.69	65.0
10	II 1	R	23.0110	15.7897	— 39	+ 1.2	+ 2.0	40 39 25.46	— 3 2.37	+ 22	+ 44	— 5	6	23.32	74.3
	2		16.2397	22.1900	— 41	+ .7	+ 1.1	40 38 53 21	— 2 30.25	— 18	+ 25	— 4	6	23.08	
	3		18.7803	20.1690	— 5	+ .1	— .3	40 35 40.19	+ 42.66	+ 6	— 2	+ 2	6	22.97	
	4		19.9813	22.7927	+ 35	+ .4	+ .1	40 37 33.66	— 1 11.13	— 8	+ 8	— 2	7	22.58	
	5		21.5140	20.5343	+ 8	— .4	— .8	40 36 47.43	— 24.77	— 3	— 17	— 1	9	22.54	
	6		9.0723 ii	32.6830 iv	+ 28	+ 1.1	+ .7	40 46 20.61	— 9 56.66	—1.05	+ 26	—17	6	23.05	
	7		25.6117	13.2350	— 59	+ 1.3	+ 1.2	40 41 36.55	— 5 13.41	— 38	+ 35	— 9	6	23.08	72.7
	8		30.6877 iv	10.4143 ii	+ 1	—1.1	—2.0	40 27 50.51	+ 8 32.26	+ 95	— 42	+ 17	8	23.58	
	9		22.7780	19.9450	+ 31	—2.1	—1.0	40 35 12.57	+ 1 11.67	+ 9	— 46	+ 3	6	23.96	
	10		27.1307 iv	17.8223 ii	+ 21	—1.3	—1.4	40 29 55.40	+ 6 26.86	+ 80	— 38	+ 12	7	22.87	71.8
	III 1	R	29.8003	13.8053	+ 253	—1.4	—1.1	40 43 8.60	— 6 44.79	— 49	— 36	— 14	10	22.92	70.8
	2		8.1283 ii	32.6333 iv	+ 15	— .8	—1.4	40 46 44.23	—10 19.22	—1.07	— 30	—23	11	23.52	71.1
	3		7.6590 ii	32.7067 iv	+ 8	— .6	— .1	40 25 48.97	+ 10 32.92	+ 1.10	— 11	+ 18	6	23.12	
	4		7.0947 ii	31.9693 iv	— 20	—1.8	—2.0	40 25 54.26	+ 10 28.47	+ 1.09	— 53	+ 19	6	23.54	
	5		27.2803	15.7877	+ 153	— .8	+ 2.7	40 31 31.48	— 4 50.78	+ 37	+ 22	— 10	7	23.02	
	6		19.2093	22.8607	+ 33	— .8	.0	40 37 55.47	— 1 32.35	— 11	— 12	— 3	6	22.92	
	7		22.6157	21.0180	+ 26	+ 1.2	— .3	40 37 3.15	— 40.49	— 4	+ 15	— 1	6	22.82	
	8		17.4600	24.0893	+ 44	— .9	— .3	40 33 31.86	+ 2 47.62	+ 21	— 18	+ 5	6	22.62	70.1
June	9		14.0007	27.7310	+ 101	— .8	—1.5	40 42 10.83	— 5 47.19	— 43	— 31	— 10	6	22.86	
11	III 1	D	11.4683	27.5190	— 71	— .1	.0	40 43 8.89	— 6 45.38	— 49	— 1	—14	10	22.97	73.8
12	II 1	D	16.9260	24.1090	+ 32	—2.6	—3.4	40 39 25.86	— 3 1.58	— 21	— 84	— 5	6	23.24	74.8
	2		21.7957	15.8257	— 63	+ 1.0	+ .8	40 38 53.66	— 2 30.69	— 17	+ 26	— 4	6	23.08	
	3		21.5113	19.8757	+ 10	— .8	— .4	40 35 40.64	+ 42.11	+ 5	— 19	+ 2	6	22.69	74.3
June															
14	II 1	D	16.3903	23.6163	0	— .6	—2.2	40 39 26.24	— 3 2.58	— 21	— 37	— 5	6	23.09	67.4
	2		22.6047	16.6387	— 20	—1.4	—1.2	40 38 51.08	— 2 30.70	— 17	— 38	— 4	6	22.85	
	3		21.4143	19.7663	+ 8	— .2	— .4	40 35 41.09	+ 41.66	+ 5	— 2	+ 2	6	22 86	
	4		21.7603	18.9093	+ 9	+ 1.1	+ .3	40 37 34.50	— 1 12.06	— 8	+ 21	— 2	7	22.62	67.0
	5		19.4953	20.5010	0	—1.6	—1.9	40 36 48.29	— 25.41	— 3	— 49	— 1	9	22.44	
	6		35.8087 iv	12.1947 ii	+ 126	+ .6	+ .1	40 41 21.60	— 9 56.99	— 99	+ 11	—17	6	23.62	
	7		14.9777	27.4117	+ 130	— .6	— .7	40 41 37.60	— 5 14.51	— 36	— 18	— 9	6	22.52	66.6
	8		9.7293 ii	29.9410 iv	— 1	— .4	—1.2	40 27 51.51	+ 8 30.70	+ 89	— 21	17	8	23.14	
	9		18.6773	21.3737	+ 1	+ .3	— .2	40 35 13.65	+ 1 8.13	+ 8	+ 2	— 3	6	21.97	*a*
	10		12.9900 ii	28.2667 iv	— 26	— .2	—1.1	40 29 56.53	+ 6 25.94	+ 75	— 17	+ 12	7	23.24	65.9
	III 1	D	10.8007	26.8940	—162	— .4	—1.4	40 43 9.76	— 6 46.23	— 46	— 24	—14	10	22.79	61.2
	2		30.1060 iv	5.5217 ii	— 89	— .4	—1.1	40 46 45.37	—10 20.96	—1.02	— 20	—23	11	23.07	61.0
	3		31.0560 iv	9.0423 ii	+ 68	—3.7	—3.7	40 25 50.28	+ 10 32.21	+ 1.02	—1.05	+ 18	6	22.70	
	4		31.3469 iv	6.5390 ii	— 46	— .9	—1.9	40 25 55.55	+ 10 26.72	+ 1.02	— 38	+ 19	6	23.16	60.8
	5		13.4723	24.9193	— 81	+ .7	— .1	40 31 32.73	+ 4 49.79	+ 32	+ 9	+ 10	7	23.10	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
June								° ′ ″						° ′ ″	°
15	II 1	R	23.1823	15.9227	— 28	+1.3	+1.5	40 39 26.42	— 3 3.36	— 21	+ 39	— 5	6	40 36 23.25	70.3
	2		15.6340	21.6307	— 71	+ .3	+ .2	40 38 54.26	— 2 31.34	— 17	+ 8	— 4	6	22.85	
	3		19.3667	21.0097	+ 1	— .6	.0	40 35 41.30	+ 41.52	+ 5	— 9	+ 2	6	22.86	69.5
	4		19.5533	22.4333	+ 24	+ .4	+1.1	40 37 34.70	— 1 12.83	— 8	+ 20	— 2	7	22.04	
	5		22.3440	21.3347	+ 17	— .4	— .7	40 36 48.50	— 25.55	— 3	— 15	— 1	9	22.85	
	6		8.7223 ii	32.3683 iv	+ 13	— .3	— .1	40 46 21.83	— 9 57.51	— 99	— 6	—17	6	23.16	68.6
	7		25.4000	12.9547	— 88	— .7	— .6	40 41 37.85	— 5 14.24	— 36	— 18	— 9	6	23.04	
	8		31.5880 iv	11.3690 ii	+ 3	+ .6	— .1	40 27 51.75	+ 8 30.89	+ 89	+ 8	+17	8	23.86	
	9		22.8817	20.1473	+ 35	+ .4	— .1	40 35 13.91	+ 1 9.18	+ 8	+ 5	+ 3	6	23.31	
	10		27.1400 iv	11.8713 ii	+ 21	—1.5	—1.4	40 29 56.80	+ 6 25.86	+ 75	— 42	+12	7	23.18	67.1
	III 1	R	30.1150	14.0707	+292	—1.3	— .9	40 43 10.06	— 6 46.14	— 46	— 32	—14	10	23.10	65.6
	2		7.5430 ii	32.1317 iv	— 7	+ .5	— .2	40 46 45.67	—10 21.28	—1.02	+ 5	—23	11	23.30	66.1
	3		8.7020 ii	33.6783 iv	+ 52	.0	— .9	40 25 50.63	+10 31.22	+1.02	— 11	+18	6	23.00	
	4		7.9033 ii	32.7320 iv	+ 14	—2.8	—2.4	40 25 55.89	+10 27.40	+1.02	— 74	+19	6	23.82	
	5		26.2777	14.8374	+ 56	—1.2	+2.0	40 31 33.06	+ 4 49.21	+ 32	— 44	+10	7	22.32	65.2
	6		19.1923	22.9113	+ 34	— .6	+1.2	40 37 57.12	— 1 34.06	— 11	+ 6	— 3	6	23.04	
	7		21.3033	19.6357	+ 7	+1.6	+ .5	40 37 4.79	— 42.15	— 5	+ 32	— 1	6	22.96	
	8		16.9993	23.5610	+ 17	— .5	+ .1	40 33 36.50	+ 2 45.84	+ 19	— 6	+ 5	6	22.58	
June	9		13.8800	27.6900	+ 95	—1.4	—1.0	40 42 12.44	— 5 49.19	— 40	— 35	—10	6	22.46	65.9
17	II 1	D	16.5460	23.8037	+ 1	—1.3	—1.4	40 39 26.71	— 3 3.39	— 21	— 38	— 5	6	22.74	78.1
	2		23.2100	17.2190	+ 10	— .4	— .6	40 38 54.58	— 2 31.40	— 17	— 14	— 4	6	22.89	
	3		20.8590	19.2243	+ 1	—1.2	— .3	40 35 41.65	+ 41.31	+ 5	— 22	+ 2	6	22.87	
	4		21.7213	18.8603	+ 8	—1.0	—1.2	40 37 35.05	— 1 12.31	— 8	— 30	— 2	7	22.41	78.2
	5		18.7587	19.7873	— 6	—1.5	—1.4	40 36 48.85	— 25.98	— 3	— 41	— 1	9	22.51	
	6		32.7213 iv	9.0660 ii	+ 29	— .8	—1.2	40 46 22.25	— 9 57.79	— 99	— 28	—17	6	23.08	77.8
	7		11.8930	24.4187	—201	+1.7	+2.1	40 41 38.30	— 5 15.99	— 36	+ 54	— 9	6	22.46	
	8		9.3653 ii	29.5370 iv	— 1	— .4	— .7	40 27 52.17	+ 8 29.69	+ 89	— 15	+17	8	22.85	
	10		13.2697 ii	28.5057 iv	— 37	+ .8	+ .7	40 29 57.31	+ 6 24.88	+ 75	+ 22	+12	7	23.35	76.1
	III 1	D	10.9837	27.0980	—135	— .7	— .2	40 43 10.63	— 6 46.83	— 46	— 13	—14	10	23.17	74.0
	3		31.9013 iv	6.9553 ii	— 24	— .6	—1.3	40 25 51.30	+10 30.26	+1.02	— 26	+18	6	22.56	
	4		30.5727 iv	5.7870 ii	— 76	+ .6	— .1	40 25 56.55	+10 26.08	+1.02	+ 8	+19	6	23.98	
	5		13.6513	25.0707	— 64	+1.2	+ .1	40 31 33.70	+ 4 48.38	+ 32	+ 20	+10	7	22.77	
	6		22.0593	18.3087	+ 5	+ .9	— .2	40 37 57.79	— 1 34.78	— 11	+ 12	— 3	6	23,05	
	7		18.4053	20.0577	— 12	— .3	—1.3	40 37 5.47	— 41.72	— 5	— 21	— 1	6	[23.54]	73.1*d*
	8		23.3087	16.7643	+ 1	+ .3	— .8	40 33 37.19	+ 2 45.36	+ 19	— 5	+ 5	6	22.80	
June	9		24.0470	10.1900	—347	— .4	— .7	40 42 13.12	— 5 49.26	— 40	— 15	—10	6	23.27	72.9
18	II 1	R	23.1620	15.8973	— 30	— .6	.0	40 39 26.82	— 3 3.49	— 21	— 9	— 5	6	23.04	79 1
	2		16.4190	22.4373	— 31	+ .2	— .1	40 38 54.71	— 2 31.99	— 17	+ 2	— 4	6	22.59	79.1
June	3		18.4570	20.0760	— 11	+1.4	+ .8	40 35 41.80	+ 40.88	+ 5	+ 32	+ 1	6	23.12	
20	II 1	R	24.4103	17.1450	+ 50	+ .8	— .6	40 39 27.04	— 3 3.70	— 21	— 2	— 5	6	23.12	
	2		19.2960	25.2747	+119	+ .7	+ .1	40 38 54.95	— 2 31.37	— 17	+ 12	— 4	6	23.55	74.3
	3		19.5790	31.2213	+ 5	—2.3	—3.1	40 35 42.08	+ 41.51	+ 5	— 76	+ 1	6	22.95	
	4		20.4147	23.3003	+ 46	— .8	+ .1	40 37 35.45	— 1 13.03	— 8	— 11	— 2	7	22.28	
	5		21.2477	20.2097	+ 6	— .4	—1.9	40 36 49.24	— 26.24	— 3	— 30	— 1	9	22.75	73.4
	6		8.1757	31.8583	— 0	—1.2	—2.0	40 46 22.75	— 9 58.40	— 99	— 44	—17	6	22.81	
	7		26.3447	13.8623	+ 11	.0	— .4	40 41 38.85	— 5 15.43	— 36	— 5	— 9	6	22.98	
	10		27.2823 iv	12.0553 ii	+ 15	—2.1	—2.2	40 29 57.93	+ 6 24.79	+ 75	— 61	+12	7	23.05	71.2
	III 1	R	30.3157	14.2320	+318	—2.4	—1.3	40 43 11.35	— 6 47.20	— 46	— 55	—14	10	23.10	67.6
	2		9.6170 ii	34.2397 iv	+ 78	+ .5	— .2	40 46 46.98	—10 22.35	—1.02	+ 5	—23	11	23.54	
	3		9.0700 ii	33.9690 iv	+ 65	+1.3	— .2	40 25 52.17	+10 29.31	+1.02	+ 18	+18	6	22,92	
	4		7.6717 ii	32.4107 iv	+ 1	—2.4	—2.5	40 25 57.42	+10 25.10	+1.02	— 70	+19	6	23.09	67.8
	6		18.0483	21.8493	— 1	— .3	+ .5	40 37 58.70	— 1 36.04	— 11	+ 1	— 3	7	22.60	
	7		21.4290	19.7017	+ 8	+ .4	— .1	40 37 6.40	— 43.66	— 5	+ 5	— 1	6	22.79	
	8		18.1717	24.6617	+ 81	+ .3	— .3	40 33 38.11	+ 2 44.19	+ 19	+ 1	+ 5	6	22.61	67.8
	9		14.7577	28.6123	+203	—1.6	.0	40 42 14.04	— 5 50.59	— 40	— 25	—10	6	22.76	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
June								° ′ ″						° ′ ″	°
22	II 1	D	14.9940	22.3150	— 85	+ .2	+ 1.4	40 39 27.28	— 3 4.77	— 21	+ 20	— 5	6	40 36 22.51	78.0
	2		22.5197	16.5040	— 26	— .1	+ .1	40 38 55.25	— 2 31.94	— 17	0	— 4	6	23.16	
	3		19.7767	18.1690	— 14	— .5	— .1	40 35 42.36	+ 40.59	+ 5	— 9	+ 1	6	22.98	
	4		21.0363	18.1510	— 11	— .6	—1.0	40 37 35.72	— 1 12.88	— 8	— 22	— 2	7	22.59	77.8
	5		17.8397	18.9060	— 16	—2.9	— .5	40 36 49.51	— 26.90	— 3	— 53	— 1	9	22.13	
	6		31.8130iv	8.1360ii	— 1	—2.1	—2.4	40 46 23.08	— 9 58.26	— 99	— 63	—18	6	23.08	
	7		12.6720	25.1740	—118	—2.1	—1.6	40 41 39.20	— 5 15.60	— 36	— 53	— 9	6	22.68	75.6
	8		9.0497,ii	29.2160iv	— 1	—1.3	—1.8	40 27 53.14	+ 8 29.55	+ 89	— 43	+ 17	8	23.40	
	10		11.5823ii	26.7550iv	+ 35	.0	— .8	40 29 58.33	+ 6 23 47	+ 75	— 10	+ 12	7	22.64	74.9
	III 1	D	12.4693	28.6063	+ 82	—1.7	—1.8	40 43 11.79	— 6 47.95	— 46	— 50	—14	10	22.84	73.9
	2		30.4007iv	5.7160ii	— 79	+ .8	— .2	40 46 47.42	—10 23.52	—1.02	+ 9	—23	11	22.85	
	3		34.3783iv	9.5040ii	+ 82	— .0	+ .2	40 25 52.71	+10 28.72	1.02	+ 2	+ 18	6	22.71	74.7
	4		31.9827iv	7.2657ii	— 16	—1.0	—1.0	40 25 57.95	+10 24.50	+ 1.02	— 28	+ 19	6	23.44	73.9
	6		21.8460	18.0397	— 1	+1.1	+ .2	40 37 59.25	— 1 36.17	— 11	+ 19	— 3	6	23.19	
	8		23.1097	16.6077	— 9	—1.7	— .8	40 33 38.67	+ 2 44.27	+ 19	— 37	+ 5	6	22.87	
June	9		25.3720	11.4643	—194	— .4	— .9	40 42 14.59	— 5 50.92	— 40	— 18	—10	6	23.05	73.7
27	II 2	R	16.3307	22.3807	— 35	— .9	—1.7	40 38 56.01	— 2 32.78	— 17	— 36	— 4	6	22.72	76.8
	3		19.7153	21.2843	+ 6	— .9	— .7	40 35 43.26	+ 39.66	+ 5	— 23	+ 1	6	22.81	
	4		19.4240	22.3367	+ 22	—1.0	— .7	40 37 36.57	— 1 13.65	— 8	— 25	— 2	7	22.64	
	5		21.8700	20.7650	+ 12	— .6	.0	40 36 50.40	— 27.95	— 3	— 9	— 1	9	22.41	
	6		8.2440ii	31.9690iv	+ 2	—1.2	—1.2	40 46 24.09	— 9 59.48	— 99	— 34	—18	6	23.16	76.4
	7		26.9333	14,3777	+ 68	2.0	+ .9	40 41 40.29	— 5 17.42	— 36	+ 43	— 9	6	22.91	76.0
	8		31.3457iv	11.2497ii	— 1	+ 1.5	+ .4	40 27 54.04	+ 8 27.78	+ 89	+ 29	+ 17	8	23.25	
June	10		27.6953iv	12.5883ii	+ 4	+ 1.9	+1.8	40 29 59 54	+ 6 21.73	+ 75	+ 53	+ 12	7	22.74	75.9
28	II 2	D	23.3057	17.2330	+ 13	+ 1.2	+2.6	40 38 56.16	— 2 33.48	— 17	+ 54	— 4	6	23.07	74.9
	3		18.4433	16.8877	— 31	+ 1.0	+1.2	40 35 43.42	+ 39.23	+ 5	+ 31	+ 1	6	23.08	
	4		22.3613	19.4280	+ 23	— .6	+ .1	40 37 36.74	— 1 14.18	— 8	+ 11	— 2	7	22.64	73.9
	5		20.4690	21.5780	+ 10	+ 1.3	+ .7	40 36 50.56	— 28.05	— 3	+ 29	— 1	9	22.85	
	6		31.9140iv	8,1670ii	+ 1	— .2	— .2	40 46 24.29	—10 0.03	— 99	— 6	—18	6	23.09	
	7		14.2953	26.8427	+ 62	—1.7	.0	40 41 40.51	— 5 17.20	— 36	— 27	— 9	6	22.65	73.9
	8		9.7523ii	29.8680iv	— 1	— .4	— .9	40 27 54.24	+ 8 28.27	+ 89	— 18	+ 17	8	23.47	
	10		11.8537ii	26.9753iv	+ 25	— .0	— .1	40 29 59.78	+ 6 22.15	+ 44	+ 2	+ 12	7	22.58	73.1
	III 1	R	30.3643	14.1830	+320	—1.2	— .5	40 43 13.38	— 6 49.67	— 46	— 25	—14	10	22.96	70.9
	2		6.8860ii	31.6173iv	— 30	— .4	—1.2	40 46 49.21	—10 24.82	—1.02	— 21	—23	11	23.04	
	3		8.3807ii	33.1867iv	+ 33	+2.2	+ .3	40 25 54.58	+10 26.87	+ 1.02	+ 38	+ 18	6	23.09	
	4		8.7643ii	33.3983iv	+ 44	—1.1	—2.2	40 25 59.78	+10 22.55	+ 1.02	— 45	+ 19	6	23.15	
	5		26.9250	15.6307	+ 127	—1.2	—1.4	40 31 36.85	+ 4 45.70	+ 32	— 36	+ 10	7	22.68	70.6
	6		18.5373	22.4010	+ 16	—1.6	—1.7	40 38 1.15	— 1 37.67	— 11	— 47	— 3	6	22.93	
	7		22.6827	20.8793	+ 28	— .5	—2.3	40 37 8.83	— 45.64	— 5	— 37	— 1	6	22.82	
	8		17.7727	24.1827	+ 53	—1.4	— .4	40 33 40.59	+ 2 42.10	+ 19	— 27	+ 5	6	22.72	
July	9		13.3890	27.3453	+ 43	—1.7	— .5	40 42 16.48	— 5 52.75	— 40	— 33	—10	6	22.96	
3	II 3	R	18.3350	19.8400	— 10	+ .7	+ 1.0	40 35 43.99	+ 38.00	+ 5	+ 23	+ 2	6	22.35	79.7
	4		19.3737	22.3373	+ 22	— .1	— .1	40 37 37.28	— 1 14.94	— 8	— 3	— 2	7	22.28	
	5		22.3053	21.1810	+ 18	— .6	— .1	40 36 51.14	— 28.45	— 3	— 11	— 0	9	22.64	.
	6		8.1597ii	31.9397iv	+ 1	— .6	— .1	40 46 25.01	—10 0.87	— 99	— 8	—18	6	22.95	79.3
	7		27.6223	15.0533	+ 147	— .1	— .1	40 41 41.33	— 5 17.96	— 36	— 3	— 9	6	22.95	
	8		31.0273iv	10.9607ii	+ 1	— .4	— .2	40 27 54.88	+ 8 27.04	+ 89	— 9	+ 17	8	22.97	78.4
	10		29.5677iv	14,4700ii	— 87	+ .2	.0	40 30 0.76	+ 6 21.26	+ 75	+ 3	+ 12	7	22.99	
	III 1	D	9.6403	25.9490	—313	+ .1	.0	40 43 14.64	— 6 51.29	— 46	+ 1	—14	10	22.86	75.8
	2		28.0960iv	3.2840ii	—180	+ .7	+ 1.0	40 46 50.31	—10 26.48	—1.02	+ 24	—23	11	22.93	
	3		32.5057iv	7.7547ii	+ 6	—1.4	— .8	40 25 56.12	+10 25.41	+ 1.02	— 32	+ 18	6	22.47	
	4		30.7387iv	6.1347ii	— 62	— .5	— .5	40 26 1.34	+10 21.53	+ 1.02	— 14	+ 19	6	24.00	
	5		12.4033	23.6473	—194	+ 1.2	+ 1.0	40 31 38.36	+ 4 43.62	+ 32	+ 31	+ 10	7	22.78	74.7
	7		17.7903	19.6993	— 18	— .4	+ .2	40 37 10.50	— 48.19	— 5	— 4	— 1	6	22.27	
	8		22.9477	16.5910	— 13	— .6	— .8	40 33 42.29	+ 2 40.59	+ 19	— 20	+ 5	6	22.98	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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July 3	III 9	D	24.1933	10.1353	—346	— .4	— .5	40 42 18.17	— 5 54.34	— 40	— 13	—10	6	40 36 23.26	74.4
5	II 3	D	21.2487	19.7213	+ 4	— .3	+ .1	40 35 44.15	+ 38.60	+ 5	— 4	+ 1	6	22.83	69.4
	4		19.8970	16.9320	— 41	— .9	— .5	40 37 37.44	— 1 14.81	— 8	— 21	— 2	7	22.39	
	5		18.8150	19.9427	— 7	— .9	— .9	40 36 51.31	— 28.48	— 3	— 26	0	9	22.63	
	6		32.2340iv	8.4437ii	+ 11	— .9	.0	40 46 25.23	—10 1.15	— 99	— 14	—18	6	22.83	68.9
	7		14.9567	27.5530	+138	— .4	— .3	40 41 41.58	— 5 18.63	— 36	— 10	— 9	6	22.46	68.1
	8		9.7807ii	29.8447iv	0	— .1	.0	40 27 55.25	+ 8 26.97	+ 89	— 1	+17	8	23.35	
	10		12.3277ii	27.3910iv	+ 6	+ .6	.0	40 30 1.07	+ 6 20.63	+ 75	+ 10	+12	7	22.74	68.5
	III 1	R	29.7010	13.4353	+222	— .9	— .5	40 43 15.04	— 6 51.56	— 46	— 21	—14	10	22.77	66.6d
	2		6.9693ii	31.7533iv	— 27	—1.0	— .7	40 46 50.72	—10 26.16	—1.02	— 25	—23	11	23.17	
	3		9.3133ii	34.0423iv	+ 69	+1.9	+ .1	40 25 56.62	+10 25.02	+1.02	+ 32	+18	6	23.22	
July 4			7.5640ii	32.1083iv	— 7	—2.1	—2.0	40 26 1.84	+10 20.16	+1.02	— 58	+19	6	22.69	66.8
9	III 1	D	10.9800	27.3130	—122	— .6	— .5	40 43 15.93	— 6 32.40	— 48	— 16	—14	10	22.85	59.1
	2		32.3247iv	7.4885ii	— 2	— .3	+ .7	40 46 51.62	—10 27.55	—1.06	+ 4	—24	11	22.92	
	3		32.4363iv	7.6983ii	+ 3	—3.4	—3.7	40 25 57.71	+10 25.08	+1.05	—1.00	+18	6	23.08	
	4		33.0963iv	8.5557ii	+ 32	—3.1	—1.9	40 26 2.92	+10 20.16	+1.05	— 74	+19	6	23.64	
	5		15.4683	26.6553	+104	— .0	—1.7	40 31 39.95	+ 4 42.93	+ 32	— 22	+10	7	23.15	
	6		23.5057	19.5090	+ 53	.0	—1.3	40 38 4.48	— 1 41.12	— 12	— 16	— 3	6	23.11	
	7		20.2543	22.1863	+ 20	—1.5	—1.5	40 37 12.21	— 48.87	— 6	— 43	— 2	6	22.89	58 5
	8		24.9110	18.6340	+ 96	— .7	—1.0	40 33 44.04	+ 2 38.85	+ 18	— 24	+ 4	6	22.93	
	9		27.5773	13.5037	+ 67	—1.0	—1.1	40 42 19.91	— 5 55.78	— 41	— 30	—10	6	23.38	57.6
	IV 1	D	21.9233	20.6823	+ 13	+1.3	— .2	40 36 54.14	— 31.39	— 4	+ 18	— 1	13	23.01	55.8
	2		20.3993	21.0507	+ 3	—2.0	— .9	40 36 39.82	— 16.47	— 2	— 43	0	10	23.00	
	3		12.7890	29.6640	+180	— .6	—1.5	40 29 15.54	+ 7 6.85	+ 49	— 28	+13	7	22.80	56.8
	4		23.2873	18.5613	+ 39	— .9	— .4	40 38 22.34	— 1 59.51	— 14	— 20	— 4	10	22.55	
	5		13.1973ii	30.6350iv	— 42	— .8	— .5	40 29 1.91	+ 7 20.50	+ 84	— 20	+13	6	23.24	
	6		30.9527iv	11.0743ii	0	—2.0	—1.6	40 28 0.37	+ 8 22.28	+ 91	— 52	+14	5	23.23	
	7		13.5607ii	29.0287iv	— 52	— .1	— .4	40 29 50.99	+ 6 30.71	+ 79	— 6	+11	5	22.59	
	8		28.6567	13.1360	+123	— .5	—1.1	40 42 56.47	— 6 32.48	— 45	— 22	—12	7	23.27	
	9		18.3313	21.2607	— 6	—2.3	—2.8	40 37 37.09	— 1 14.00	— 9	— 72	— 2	12	22.38	
	10		16.2430	24.8887	+ 43	— .3	.0	40 40 2.09	— 3 38.56	— 25	— 5	— 6	6	23.23	55.2
	11		5.7830ii	33.9913iv	— 9	—1.2	— .7	40 24 29.53	+11 52.74	+1.15	— 28	+20	7	23.41	55.6
July 12			25.6060	14.1027	— 14	— .7	+ .3	40 41 13.45	— 4 50.63	— 33	— 8	— 9	7	22.39	
10	III 1	R	29.8683	13.5290	+241	+1.1	+2.0	40 43 16.18	— 6 53.46	— 48	+ 42	—14	10	22.62	68.2
	2		8.5570ii	33.3937iv	+ 41	+ .8	+ .7	40 46 51.88	—10 27.67	—1.06	+ 22	—24	11	23.24	66.9
	3		8.0050ii	32.6490iv	+ 14	+2.4	+2.3	40 25 58.02	+10 22.78	+1.05	+ 67	+18	6	22.71	
	4		8.7317ii	33.2090iv	+ 37	+ .4	+ .5	40 26 3.23	+10 18.58	+1.05	+ 13	+19	6	23.24	
July 5			25.9337	14.7900	+ 35	—1.2	— .6	40 31 40.25	+ 4 41.66	+ 32	— 26	+10	7	22.14	65.4
11	III 1	D	12.8370	29.1720	+143	+ .8	+2.3	40 43 16.44	— 6 53.11	— 48	+ 42	—14	10	23.23	73.9
12	III 1	R	29.0620	12.6997	+125	+1.0	+1.8	40 43 16.71	— 6 53 75	— 48	+ 39	—14	10	22.83	79.0
	2		9.2537ii	34.1163iv	+ 72	+1.3	+1.6	40 46 52.42	—10 28.40	—1.24	+ 40	—24	11	23.05	
	3		8.0523ii	32.6987iv	+ 16	+ .3	+2.0	40 25 58.66	+10 22.80	+1.23	+ 30	+18	6	23.23	78.3
	4		9.5440ii	33.9783iv	+ 67	+ .7	+ .8	40 26 3.86	+10 17.57	+1.23	+ 21	+19	6	23.12	
	5		26.5570	15.4530	+ 97	+1.3	+ .2	40 31 40.88	+ 4 40.82	+ 32	+ 23	+10	7	22.42	78.4
	6		17.2810	21.3700	— 24	+1.6	+1.4	40 38 5.47	— 1 43.26	— 12	+ 43	— 3	6	22.55	
	7		21.0500	19.0327	+ 1	+1.6	+ .2	40 37 13.22	— 50.97	— 6	+ 28	— 2	6	22.51	
	8		15.9853	22.2247	— 49	+ .6	— .1	40 33 45.06	+ 2 37.53	+ 18	+ 8	+ 4	6	22.95	78.4
	9		13.2100	27.3607	+ 34	—1.0	— .1	40 42 20.93	— 5 57.64	— 41	— 17	—10	6	22.67	
	IV 1	R	20.6610	21.9337	+ 13	— .3	— .6	40 36 54.99	— 32.19	— 4	— 12	— 1	13	22.76	77.6
	2		21.9957	21.2967	+ 9	+ .2	.0	40 36 40.70	— 17.68	— 2	+ 3	0	10	23.13	
	3		28.2560	11.4143	— 25	— .7	— .2	40 29 16.46	+ 7 5.49	+ 49	— 13	+13	7	22.51	76.8
	4		17.1003	21.8880	— 21	— .1	+1.1	40 38 23.19	— 2 0.92	— 14	+ 12	— 4	10	22.31	76.8
	5		29.3623iv	11.9830ii	— 14	— .4	.0	40 29 2.78	+ 7 19.10	+1.02	— 6	+13	6	23.03	
	6		9.8267ii	29.6500iv	+ 1	+1.4	+ .9	40 28 1.27	+ 8 20.89	+1.09	+ 34	+14	5	23.78	
	7		26.5987iv	11.1683ii	+ 45	—1.7	—2.3	40 29 51.87	+ 6 30.00	+ 97	— 56	+11	5	22.44	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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July 12	IV 8	R	11.7987	27.3700	— 57	— .6	.0	40 42 57.30	— 6 33.31	— 45	— 9	—12	7	40 36 23.40	75.6
	9		22.4447	19.4967	+ 25	+ .1	— .2	40 37 37.82	— 1 14.55	— 9	— 1	— 2	12	23.27	
	10		24.5270	15.8483	+ 16	+ .6	.0	40 40 2.87	— 3 39.33	— 25	+ 9	— 6	6	23.38	
	11		33.5513iv	5.4093 II	— 37	— .6	— .9	40 24 30.28	+11 50.99	+1.33	— 21	+20	7	22.66	
	12		13.6367	25.1350	— 62	— .0	—1.1	40 41 14.17	— 4 50.38	— 33	— 14	— 9	7	23.30	75.4
July 13	III 1	D	13.9443	30.2810	+290	+ .9	+2.1	40 43 16.96	— 6 53.52	— 48	+ 41	—14	10	23.33	81.9
	2		30.7720iv	5.8833 II	— 72	+ .7	+1.6	40 46 52.69	—10 28.70	—1.24	+ 31	—24	11	22.93	81.5
	3		34.2067iv	9.5773 II	+ 76	+1.3	+2.0	40 25 58.97	+10 22.01	+1.23	+ 45	+18	6	22.90	
	4		31.1690iv	6.7063 II	— 42	+1.4	.0	40 26 4.17	+10 18.01	+1.23	+ 23	+19	6	23.89	81.2
	5		15.1510	26.2557	+ 68	+1.0	+ .7	40 31 41.20	+ 4 40.76	+ 32	+ 25	+10	7	22.70	80.6
	6		22.3433	18.2537	+ 10	+2.0	+1.5	40 38 5.81	— 1 43.36	— 12	+ 51	— 3	6	22.87	79.6
	7		18.6077	20.6130	— 7	— .7	— .2	40 37 13.56	— 50.65	— 6	— 13	— 2	6	22.76	
	8		22.2180	16.0040	— 48	—1.1	—2.5	40 33 45.41	+ 2 36.89	+ 18	— 49	+ 4	6	22.09	
	9		25.9910	11,8240	—136	.0	— .1	40 42 21 28	— 5 57.62	— 41	— 1	—10	6	23.20	77.7
	IV 1	D	20.6493	19.3720	+ 1	+ .7	— .7	40 36 55.29	— 32.28	— 4	+ 2	— 1	13	23.11	74.3
	2		18.2353	18.9683	— 9	—1.1	.0	40 36 41.01	— 18.50	— 2	— 17	0	10	22.42	
	3		11.3597	28.2093	— 32	+ .3	—1.0	40 29 16.79	+ 7 5.67	+ 49	— 7	+ 13	7	23.08	74.4
	4		20.7393	15.9650	— 69	— .8	—1.2	40 38 23.50	— 2 0.46	— 14	— 28	— 4	10	22.68	
	5		10.7817 II	28.1347iv	+ 12	— .1	— .4	40 29 3.16	+ 7 18.50	+1.03	— 6	+13	6	22.81	
	6		29.3783iv	9.5817 II	+ 1	.0	+ .2	40 28 1.60	8 20.21	+1.09	+ 2	+ 14	5	23.11	
	7		10.6077 II	26.0217iv	+ 67	— .6	— .5	40 29 52.19	+ 6 29.64	+ 97	— 16	+11	5	22.80	
	8		26.4860	10.8930	—180	— .3	—2.3	40 42 57.61	— 6 33.54	— 45	— 34	—12	7	23.23	72.6
	9		17.4717	20.4447	— 27	— .0	.0	40 37 38.08	— 1 15.05	— 9	0	— 2	12	23.04	72.8
	10		16.2730	24.9560	+ 45	—1.2	— .4	40 40 3.16	— 3 39.51	— 25	— 24	— 6	6	23 16	
	11		4.7273 II	32.8770iv	— 84	+1.0	+ .6	40 24 30.54	+11 51.06	+1.33	+ 23	+ 20	7	23.43	
July 17	12		24.2647	12.7177	—153	+ .1	+1.1	40 41 14.42	— 4 51.38	— 33	+ 15	— 9	7	22.84	71.9
	III 1	R	27.7167	11.3427	— 68	—2.4	—1.3	40 43 17.81	— 6 53.56	— 48	— 55	—14	10	23.18	75.4
	2		10.1883 II	34.9863iv	+108	+ .6	+ .6	40 46 53.58	—10 29.39	— 95	+ 17	—24	11	23.28	
	3		6.8560 II	31.4447iv	— 34	+ 1.8	+ 1.8	40 26 0.06	+10 21.21	+ 94	+ 51	+ 18	6	22.96	75.1
	4		6.7910 II	31.2030iv	— 38	+ .6	.0	40 26 5.26	+10 16.74	+ 94	+ 10	+ 19	6	23.29	
	5		26.0203	14.9500	+ 47	— .5	— .5	40 31 42.29	+ 4 39.84	+ 32	— 14	+ 10	7	22.48	
	6		16.7203	20.8430	— 44	— .7	.0	40 38 7.00	— 1 44.06	— 12	— 11	— 3	6	22.74	74.5
	7		19.3943	17.3293	— 30	+1.1	.0	40 37 14.78	— 52.10	— 6	+ 18	— 2	6	22.84	
	8		16.4527	22.6280	— 26	+ .6	+ .9	40 33 46.66	+ 2 35.97	+ 18	+ 21	+ 4	6	23.12	
	9		12.8570	27.0730	— 5	— .9	+ .2	40 42 22.55	— 5 59.19	— 41	— 12	—10	6	22.79	74.3
	IV 1	R	19.6857	21.0093	+ 3	— .8	— .4	40 36 56.46	— 33.45	— 4	— 18	— 1	13	22.91	69.6
	2		22.1360	21.3803	+ 11	+1.0	+1.4	40 36 42.21	— 19.12	— 2	— 33	0	10	22.84	
	5		28.2407iv	10.9177 II	+ 10	— .9	.0	40 29 4.47	+ 7 17.74	+ 73	— 14	+ 13	6	22.99	
July 24	6		8.6123 II	28.3640iv	+ 4	.0	— .5	40 28 2.89	8 19.09	+ 80	— 6	+ 14	5	22.91	d
	III 1	D	11.8107	28.2277	+ 3	—1.7	— .7	40 43 19.15	— 6 54.83	— 48	— 36	—14	10	23.44	70.0
	2		30.7277iv	5.8230 II	— 75	+ 1.6	+ .4	40 46 54.97	—10 29.09	— 95	+ 30	—24	11	[25.10]	*
	3		32.1230iv	7.5753 II	+ 4	—1.8	— .4	40 26 1.78	+ 10 20.27	+ 94	— 34	+ 18	6	22.89	70.0
	4		30.9720iv	6.6027 II	— 49	— .6	—1.2	40 26 6.97	+10 15.63	+ 94	— 24	+ 19	6	23.55	
	5		13.2130	24.2530	—121	+ .8	— .4	40 31 44.00	+ 4 38.65	+ 32	+ 8	+10	7	23.22	69.4
	6		23.8653	19.6937	+ 65	+ .1	— 8	40 38 8.87	— 1 45.57	— 12	— 8	— 3	6	23 13	
	7		18.2437	20.3580	— 13	—1.8	—1.9	40 37 16.70	— 53.39	— 6	— 53	— 2	6	22.76	
	8		22.3500	16.2463	— 37	— .4	— .5	40 33 48.62	+ 2 34.13	+ 18	— 13	+ 4	6	22.90	
	9		27.5530	13.2797	+ 52	+ .5	— .3	40 42 24.52	— 6 0.78	— 41	+ 4	—10	6	23.33	69.4d
	IV 1	D	20.4553	19.0700	— 2	+ .2	,0	40 36 58.21	— 35.00	— 4	+ 3	— 1	13	23.32	69.0
	2		19.4613	20.2727	— 1	—2.0	—2.9	40 36 44.04	— 20.50	— 2	— 69	— 0	10	22.93	
	3		11.1803	27.8907	— 67	+ .5	—1.4	40 29 20.06	+ 7 2.06	+ 49	— 10	+13	7	22.71	
	4		23.2290	18.3397	+ 33	—1.2	— .2	40 38 26.55	— 2 3.62	— 14	— 21	— 4	10	22.64	68.9
	5		12.6303 II	30.8740iv	— 27	+ .4	+ .2	40 29 6.48	+ 7 15.64	+ 73	+ 9	+13	6	23.13	
	7		27.4970iv	12.1737 II	+ 7	—2.8	—2.4	40 29 55.44	+ 6 27.20	+ 68	— 74	+ 11	5	22.74	
	8		11.0683	26.7820	—147	+ .2	+ .7	40 43 0.72	— 6 36.68	— 45	+ 12	—12	7	23.66	

* Instrument probably disturbed.

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
July								° ′ ″						° ′ ″	°
24	IV 9	D	22.3747	19.3193	+ 22	— .4	— .9	40 37 40.81	— 1 17.26	— 9	— 18	— 2	12	40 36 23.38	68.4
	10		23.9843	15.1797	— 32	+1.4	+ .1	40 40 6.18	— 3 42.39	— 25	+ 24	— 6	6	23.78	
	11		34.6077iv	6.5943ii	+ 42	— .2	.0	40 24 33.44	+11 47.94	+1.04	— 3	+20	7	22.66	
July	12		13.5547	25.1597	— 75	— .8	— .8	40 41 17.21	— 4 53.04	— 33	— 23	— 9	7	23.59	68.5
25	III 1	R	26.8570	10.3860	—199	+ .7	+ .2	40 43 19.38	— 6 55.68	— 48	+ 13	—14	10	23.31	78.0
	2		8.5287ii	33.4850iv	+ 43	+1.6	+1.1	40 46 55.22	—10 30.69	— 95	+ 40	—24	11	23.85	77.7
	3		8.6337ii	33.1263iv	+ 35	+2.3	+1.6	40 26 2.06	+10 18.96	+ 94	+ 56	+18	6	22.76	77.8
	4		6.7493ii	31.1077iv	— 42	—1.4	—2.0	40 26 7.26	+10 15.37	+ 94	— 47	+19	6	23.35	
	5		26.2387	15.2370	+ 71	+ .4	+ .7	40 31 44.29	+ 4 38.17	+ 32	+ 15	+10	7	23.10	77.4
	6		17.3733	21.5553	— 20	—1.5	— .4	40 38 9.18	— 1 45.62	— 12	— 29	— 3	6	23.18	
	7		20.9457	18.8147	— 3	+1.6	+ .4	40 37 17.01	— 53.84	— 6	+ 30	— 2	6	23.45	
	8		17.1653	23.2457	+ 11	— .8	—1.2	40 33 48.96	+ 2 33.66	+ 18	— 28	+ 4	6	22.62	
	9		14.3500	28.6027	+184	—1.0	—1.4	40 42 24.85	— 6 0.60	— 41	— 33	—10	6	23.47	75.3
	IV 1	R	19.9830	21.3907	+ 9	+ .4	+ .6	40 36 58.50	— 35.59	— 4	+ 14	— 1	13	23.13	72.1a
	2		21.7800	20.9513	+ 10	—2.2	—1.4	40 36 44.34	— 20.96	— 2	— 52	0	10	22.94	
	3		29.5227	12.8573	+174	—1.0	—1.2	40 29 20.38	+ 7 1.53	+ 49	— 31	+13	7	22.29	
	4		19.4510	24.3350	+ 81	—1.5	— .8	40 38 26.85	— 2 3.61	— 14	— 34	— 4	10	22.82	
	5		28.4383iv	11.2143ii	+ 3	— .7	— .4	40 29 6.81	+ 7 15.22	+ 73	— 16	+13	6	22.79	72.4
	6		9.9673ii	29.6180iv	— 2	+1.6	+ .4	40 28 5.21	+ 8 16.52	+ 80	+ 30	+14	5	23.02	
	7		28.0500iv	12.7507ii	— 18	—1.2	—1.6	40 29 55.76	+ 6 26.53	+ 68	— 39	+11	5	22.74	72.1
	8		12.9960	28.6840	+117	—1.5	—1.6	40 43 0.49	— 6 36.69	— 45	— 44	—12	7	22.86	
	9		24.2690	21.2307	+ 73	— .8	—1.5	40 37 41.07	— 1 16.95	— 9	— 32	— 2	12	23.81	
	10		24.5113	15.7043	+ 8	+ .1	— .2	40 40 6.47	— 3 42.55	— 25	— 1	— 6	6	23.66	
	11		35.0247iv	7.0310ii	+ 72	—1.0	—1.3	40 24 33.72	+11 47.52	+1.04	— 33	+20	7	[22.22]	*
	12		15.0113	26.6280	+ 83	— .4	— .5	40 41 17.47	— 4 53.74	— 33	— 13	— 9	7	23.25	71.8
Aug.															
5	III 1	D	15.9573	32.4590	—606	—1.2	—1.0	40 43 21.20	— 6 58.73	+ 17	— 32	—14	9	22.27	67.7†
	2		32.3293iv	7.3310ii	— 8	— .8	—1.7	40 46 57.18	—10 31.99	—1.28	— 34	—25	11	23.43	66.3
	3		34.9670iv	10.5520ii	+106	—1.9	— .9	40 26 4.53	+10 17.54	+1.29	— 42	+18	5	23.17	
	4		33.5277iv	9.3250ii	+ 52	— .4	— .2	40 26 9.74	+10 12.03	+1.29	— 7	+18	6	23.23	
	5		14.9977	25.9073	+ 43	+ .8	+ .6	40 31 46.83	+ 4 35.93	— 11	+ 20	+ 9	7	23.01	65.8
	6		23.2123	18.8963	+ 40	— .2	— .8	40 38 12.00	— 1 49.22	+ 4	— 13	— 3	6	22.72	
	7		18.2310	20.4863	— 12	— .5	— .9	40 37 19.94	— 56.99	+ 2	— 19	— 2	6	22.82	
	8		23.8857	17.9057	+ 47	—1.6	—1.0	40 33 51.98	+ 2 31.31	— 6	— 38	+ 4	6	22.95	
	9		26.2977	11.8497	—116	—1.1	—1.6	40 43 27.93	— 6 4.99	+ 15	— 38	—10	5	22.66	64.0
	IV 1	D	20.1497	18.6177	— 8	+2.4	.0	40 37 1.55	— 38.71	+ 2	+ 39	— 1	13	23.37	60.9
	2		18.4500	19.4040	— 9	—2.4	—2.3	40 36 47.52	— 24.10	+ 1	— 68	— 1	11	22.85	
	3		11.7290	28.3297	+ 19	— .7	—1.8	40 29 23.83	+ 6 59.75	— 16	— 34	+13	7	23.28	
	4		21.8590	16.8027	— 30	+ .4	.0	40 38 30.10	— 2 7.76	+ 5	+ 6	— 4	10	22.51	61.0
	5		11.2040ii	28.2767iv	+ 7	— .6	—2.3	40 29 10.38	+ 7 11.65	+1.36	— 38	+12	6	23.19	61.1
	6		29.8230iv	10.3120ii	0	—2.1	—1.8	40 28 8.77	+ 8 13.28	+1.34	— 56	+13	5	23.01	
	7		11.4410ii	26.5513iv	+ 43	+ .4	—1.1	40 29 59.30	+ 6 22.13	+1.38	— 7	+11	6	22.91	
	8		26.1637	10.2742	—225	+ .1	— .6	40 43 4.42	— 6 41.15	+ 16	— 6	—12	7	23.32	60.9
	9		17.4260	20.6137	— 28	—2.4	—2.4	40 37 44.09	— 1 20.27	+ 3	— 69	— 2	11	23.25	
	10		15.5473	24.5003	+ 2	—2.0	—1.3	40 40 9.84	— 3 46.36	+ 9	— 49	— 6	6	23.08	60.2
	11		6.7920ii	34.6993iv	+ 51	—1.5	—1.5	40 24 36.98	+11 45.69	+1.25	— 43	+21	6	23.76	
Aug.	12		25.6910	13.8953	— 21	— .1	+ .1	40 41 20.64	— 4 58.17	+ 12	— 0	— 9	7	22.57	60.3
6	III 1	R	29.0530	12.4807	+110	.0	+1.3	40 43 21.43	— 6 59.26	+ 17	+ 16	—15	9	22.44	69.0
	2		9.1623ii	34.2177iv	+ 75	+1.3	+2.6	40 46 57.16	—10 33.65	—1.28	+ 54	—24	11	22.64	
	3		7.7030ii	32.0973iv	— 5	+1.4	+ .3	40 26 4.81	+10 16.73	+1.29	+ 26	+18	5	23.32	
	4		9.1787ii	33.3690iv	+ 47	+ .4	.0	40 26 9.97	+10 11.71	+1.29	+ 6	+18	6	23.27	
	5		26.5083	15.6217	+100	— .4	+ .9	40 31 47.07	+ 4 35.49	— 11	+ 5	+ 9	7	22.66	69.4
	6		18.0220	22.3563	+ 8	—1.3	— .2	40 38 12.26	— 1 49.60	+ 4	— 23	— 3	6	22.50	69.8
	7		20.7910	18.4823	— 8	+1.4	+ .9	40 37 20.20	— 58.35	+ 2	+ 34	— 2	6	22.25	
	8		17.7787	23.7367	+ 40	— .9	— .6	40 33 52.25	+ 2 30.73	— 6	— 22	+ 4	6	22.80	
	9		12.7277	27.1853	— 3	—2.0	— .9	40 42 28.21	— 6 5.51	+ 15	— 44	—10	5	22.36	69.1

* Probably bisected with thread V by mistake. † Outside micrometer limit.

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
								° ′ ″						° ′ ″	°
Aug. 6	IV 1	R	19.5837	21.1100	— 3	—1.7	—1.7	40 37 1.81	— 38.60	+ 2	— 49	— 1	13	40 36 22.86	65.2
	2		25.0143	24.0433	+ 37	—1.6	—1.6	40 36 47.79	— 24.64	+ 1	— 46	— 1	11	22.80	
	3		27.9357	11.3527	— 52	—1.7	— .9	40 29 24.13	+ 6 59.12	— 16	— 39	+ 13	7	22.90	
	4		18.7967	23.8440	+ 58	—1.2	—1.0	40 38 30.37	— 2 7.75	+ 5	— 32	— 4	10	22.41	64.4
	5		28.0920 iv	11.0807 ii	+ 12	+ .6	+ .4	40 29 10.68	+ 7 10.12	+ 1.36	+ 15	+12	6	22.49	
	6		9.1027 ii	28.5907 iv	+ 5	.0	— .4	40 28 9.07	+ 8 12.71	+ 1.34	— 5	+ 13	5	23.25	
	7		27.0347 iv	11.9453 ii	+ 22	— .3	+ .8	40 29 59.60	+ 6 21.55	+ 1.38	+ 5	+ 11	6	22.75	
	8		12.4307	28.3037	+ 50	— .7	— .4	40 43 4.70	— 6 41.43	+ 16	— 16	—12	7	23.22	
	9		21.7927	18.5610	— 4	— .4	+ .8	40 37 44.34	— 1 21.69	+ 3	+ 3	— 2	11	22.80	64.6
	10		24.2853	15.2787	— 22	+ .8	— .6	40 40 10.13	— 3 47.67	+ 9	+ 5	— 6	6	22.60	63.9
	11		33.2097 iv	5.3243 ii	— 51	—1.6	— .5	40 24 37.25	+ 11 44.88	+ 1.25	— 32	+21	6	23.33	
Aug. 9	III 1	D	13.2903	29.8677	+ 226	— .3	+ 1.0	40 43 21.93	— 6 59.69	+ 17	+ 7	—15	9	22.42	72.0
	2		30.9057 iv	5.8177 ii	— 74	+ 1.5	+ 1.3	40 46 57.97	—10 34.10	—1.28	+ 40	—24	11	22.86	71.2
	3		32.5387 iv	8.1757 ii	+ 14	— .2	+ 1.7	40 26 5.48	+ 10 15.99	+ 1.29	+ 18	+ 18	5	23.17	
	4		32.4537 iv	8.2793 ii	+ 14	+ 1.2	2.0	40 26 10.70	+ 10 11.22	+ 1.29	+ 45	+ 18	6	23.90	
	5		14.5917	25.4540	+ 3	+ .7	+ .1	40 31 47.82	+ 4 34.63	— 11	+ 13	+ 9	7	22.63	70.4
	6		22.0567	17.6593	— 8	2.6	+ 1.3	40 38 13.09	— 1 51.16	+ 4	+ 58	— 3	6	22.58	
	7		18.6363	20.9653	— 7	+ 1.3	+ 1.7	40 37 21.06	— 58.86	+ 2	+ 42	— 2	6	22.68	
	8		22.4127	16.5063	— 29	+ 2.7	+ 2.1	40 33 53.13	+ 2 29.25	— 6	+ 70	4	6	23.12	
	9		25.9370	11.4433	—164	+ .2	—1.3	40 42 29.07	— 6 6.02	+ 15	— 13	—10	5	23.02	70.2
	IV 1	D	20.1017	18.5273	— 10	+ 1.5	+ .9	40 37 2.67	— 39.78	+ 2	+ 35	— 1	13	23.38	65.6
	2		19.1140	20.1817	— 3	+ 1.5	+ 1.7	40 36 48.68	— 26.99	+ 1	+ 45	— 9	11	22.17	65.7
	3		11.6737	28.2053	— 11	+ 1.0	—2.2	40 29 25.09	+ 6 57.93	— 16	— 11	+ 13	7	22.95	
	4		21.4637	16.3267	— 51	+ 2.0	+ 1.5	40 38 31.28	— 2 9.75	+ 5	+ 51	— 4	10	22.15	
	5		11.4110 ii	28.3890 iv	+ 4	+ .3	+ .4	40 29 11.67	+ 7 9.25	+ 1.36	+ 10	+12	6	22.56	
	6		30.7027 iv	10.2720 ii	+ 2	— .6	— .2	40 28 10.06	+ 8 11.26	+ 1.34	— 12	+ 13	5	22.72	64.1
	7		13.3893 ii	28.4150 iv	— 40	+ 1.7	1.7	40 30 0.58	+ 6 19.78	+ 1.38	+ 49	+ 11	6	22.40	
	8		27.5413	11.5790	— 60	2.4	+ 1.2	40 43 5.64	— 6 43.41	16	+ 54	—12	7	22.88	
	9		18.3020	21.5840	— 3	+ .6	+ .8	40 37 45.17	— 1 22.97	+ 3	+ 19	— 2	11	22.51	63.9
	10		15.7183	24.7423	+ 17	—1.5	— .7	40 40 11.05	— 3 48.19	+ 9	— 33	— 6	6	22.62	
	11		5.1763 ii	33.0077 iv	— 62	— .3	— .5	40 24 38.13	+ 11 43.49	1.25	— 11	+ 21	6	23.03	
Aug. 10	III 1	R	23.7743	11.9157	—224	— .7	— .9	40 41 21.75	— 4 59.25	+ 12	— 23	— 9	7	22.37	64.4
	2		27.7503	11.1680	— 78	—1.0	—1.1	40 43 22.10	— 6 59.04	+ 17	— 30	—15	9	22.87	67.5
	3		8.5830 ii	33.6800 iv	+ 52	+ 1.7	+ 1.4	40 46 58.16	—10 34.64	—1.28	+ 45	—24	11	22.56	67.2
	4		7.4670 ii	31.8207 iv	— 16	+ 2.3	3.7	40 26 5.71	+ 10 15.68	+ 1.29	+ 83	+ 18	5	23.74	68.6
	5		7.5190 ii	31.6727 iv	— 15	3.4	+ 1.9	40 26 10.93	+ 10 10.62	+ 1.29	78	18	6	23.86	
	6		25.9263	15.0437	+ 46	—2.6	—1.2	40 31 48.07	+ 4 35.25	— 11	— 57	+ 9	7	22.80	67.0
	7		18.6507	23.0067	+ 31	—2.0	—1.2	40 38 13.35	— 1 50.21	+ 4	+ 47	— 3	6	22.74	65.1
	8		21.2137	18.9210	0	—2.2	—2.7	40 37 21.38	— 57.96	+ 2	— 69	— 2	6	22.74	
	9		17.0610	22.9917	0	—1.4	—1.8	40 33 53.42	+ 2 29.94	— 6	+ 45	+ 4	6	22.95	
	10		13.6693	28.1710	+ 116	+ .2	+ 2.0	40 42 29.40	— 6 6.93	+ 15	+ 28	—10	5	22.85	65.0
	IV 1	R	20.2323	21.8077	— 13	— .6	.0	40 37 2.97	— 39.86	+ 2	+ 9	— 1	13	23.16	62.1
	2		22.4353	21.4093	— 15	—2.2	—2.0	40 36 49.00	— 25.90	+ 1	— 60	— 1	11	22.61	
	3		28.0990	11.5813	— 22	+ .3	.0	40 29 25.44	+ 6 57.55	+ 16	+ 5	+ 13	7	23.08	62.5
	4		18.2380	23.3487	+ 36	—1.8	+ .2	40 38 31.60	— 2 9.30	+ 5	— 26	— 4	10	22.15	
	5		28.2227 iv	11.2680 ii	+ 8	+ .5	+ 1.5	40 29 12.02	+ 7 8.67	1.36	+ 27	+ 12	6	22.50	
	7		26.8863 iv	11.8420 ii	+ 28	—1.8	— .8	40 30 0.92	+ 6 20.43	+ 1.38	— 39	+ 11	5	22.50	61.7
	8		13.0463	28.9827	+ 132	—1.2	— .3	40 43 5.97	— 6 43.24	+ 16	— 23	—12	7	22.61	62.0
	9		21.7623	18.5030	+ 3	— .2	— .6	40 37 45.47	— 1 22.41	+ 3	— 10	— 2	11	23.08	
	10		24.1673	15.1137	— 28	+ 2.6	+ 1.2	40 40 11.38	— 3 48.83	+ 9	+ 57	— 6	6	23.21	61.6
	11		34.4823 iv	6.6900 ii	+ 41	+ 1.2	+ 3.1	40 24 38.45	+ 11 42.76	+ 1.25	+ 58	+ 21	6	23.31	62.0
Aug. 20	III 2	D	32.1530 iv	7.0097 ii	— 19	+ 1.1	+ 1.1	40 46 59.41	—10 35.63	—1.28	+ 32	—24	11	22.69	68.8
	3		32.3123 iv	8.0093 ii	+ 6	—1.1	— .8	40 26 7.35	+ 10 14.45	+ 1.29	— 28	+ 18	5	23.04	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Aug.								° ′ ″						° ′ ″	°
20	III 5	D	14.2933	25.0670	− 30	+1.3	+1.5	40 31 49.82	+ 4 33.31	− 11	+ 40	+ 9	7	40 46 22.58	69.1
	6		21.8910	17.4120	− 14	+2.8	+1.9	40 38 14.93	− 1 53.20	+ 4	+ 69	− 3	6	22.49	
	7		18.5790	21.9957	+ 8	+2.0	+2.1	40 37 23 45	− 1 1.12	+ 2	+ 59	− 2	6	22.98	
	8		23.0963	17.2647	+ 9	+ .1	− .1	40 33 55.65	+ 2 27.46	− 6	− 0	+ 4	6	23.15	68.8
	9		27.3607	12.7880	+ 11	.0	−1.0	40 42 31.70	− 6 8.46	+ 15	− 8	−10	5	23.26	
	IV 1	D	19.8037	18.1190	− 15	− .8	− .6	40 37 5.44	− 42.56	+ 2	− 20	− 1	13	22.82	65.1
	2		18.7097	19.8210	− 7	−4.0	−4.4	40 36 51.60	− 28.08	+ 1	−1.21	− 1	11	22.42	65.1
	3		9.9943	26.4390	−253	− .6	−1.6	40 29 28.31	+ 6 55.12	− 16	− 29	+13	7	23.18	
	4		21.0033	15.7903	− 74	−1.2	−1.5	40 38 34.31	− 2 11.61	+ 5	− 39	− 4	10	22.42	
	5		11.1953 II	28.0667 IV	+ 11	− .8	− .1	40 29 15.04	+ 7 6.58	+1.36	− 14	+12	6	23.02	
	6		28.8227 IV	9.4947 II	+ 4	−2.4	−1.8	40 28 13.47	+ 8 8.67	+1.34	− 61	+13	5	23.05	64.9
	7		11.8333 II	26.7490 IV	+ 34	+ .5	− .2	40 30 3.97	+ 6 17.19	+1.38	+ 5	+11	6	22.76	
	8		26 6020	10.5203	−201	+ .7	+ .8	40 43 8.92	− 6 46.07	+ 16	+ 21	−12	7	23.17	
	9		17.5217	20.8960	+ 36	+ .7	− .4	40 37 48.08	− 1 25.25	+ 3	+ 6	− 2	11	23.01	
	10		15.4743	24.6667	+ 5	+ .1	+ .5	40 40 14.36	− 3 52.42	+ 9	+ 8	− 6	6	22.11	63.7
	11		5.3883 II	33.0940 IV	− 51	+2.3	+1.8	40 24 41.34	+11 40.33	+1.25	+ 59	+21	6	23 78	
Aug.	12		25.3800	13.3847	− 65	+ .9	+ .2	40 41 24.88	− 5 3.10	+ 12	+ 17	− 9	7	22.05	64.1
21	III 1	R	28.1383	11.4787	− 28	+ .6	+1.1	40 43 23.34	− 7 1 12	+ 17	+ 23	−15	9	22.56	65.8
	2		8.4330 II	33.5760 IV	+ 45	+ .7	+ .6	40 46 59.57	−10 35.79	−1.28	+ 19	−24	11	22.56	
	3		7.3380 II	31.6303 IV	− 21	+1.9	+1.6	40 26 7.54	+10 14.11	+1.29	+ 50	+18	5	23.67	65.1
	4		8.3317 II	32.4220 IV	+ 14	− .9	−2.2	40 26 12.79	+10 9.09	+1.29	− 42	+18	6	22.99	
	5		26.8327	16.0437	+135	−1.5	− .7	40 31 50.03	+ 4 33.11	− 11	− 33	+ 9	7	22.86	61.7
	6		18 4393	22.8666	+ 24	−3.2	−2.8	40 38 15.59	− 1 51.99	+ 4	− 87	− 3	6	22.80	
	7		21.7157	19.3160	+ 9	.0	+1.2	40 37 23.68	− 1 0.69	+ 2	+ 15	− 2	6	23.20	60.7
	8		17.6883	23.5060	+ 32	−1.8	− .6	40 33 55.89	+ 2 27.17	− 6	− 36	+ 4	6	22.74	
Aug.	9		13.3310	27.9343	+ 92	− .8	+ .7	40 42 31.95	− 6 9.44	+ 15	− 4	−10	5	22.57	61.1
22	III 1	D	12.5590	29.1960	+125	+ .7	+2.3	40 43 23.48	− 7 0.94	+ 17	+ 40	−14	9	23.06	67.8
	2		30.6030 IV	5.4303 II	− 90	+1.5	+ .8	40 46 59.73	−10 36.20	−1.28	+ 34	−25	11	22.45	67.0
	3		32.5860 IV	8.3010 II	+ 17	−1.5	−1.9	40 26 7.73	+10 14.02	+1.29	− 48	+18	5	22.79	
	4		30.8083 IV	6.7087 II	− 46	+2.0	+1.1	40 26 12.91	+10 9.18	+1.29	+ 46	+18	6	24.08	
	5		15 3690	26.1620	+ 73	− .6	−1.3	40 31 50.24	+ 4 33.06	− 11	− 26	+ 9	7	23.09	66.4
	6		22.8587	18.3827	+ 24	+1.5	− .1	40 38 15.82	− 1 53.22	+ 4	+ 22	− 3	6	22.89	65.8
	7		19.1793	21.6013	+ 7	+ .2	− .4	40 37 23.93	− 1 1.25	+ 2	− 2	− 2	6	22.72	66.4
	8		24.2670	18.4723	+ 72	+1.0	+ .4	40 33 56.15	+ 2 26.69	− 6	+ 21	+ 4	6	23.09	
	9		26.7193	12.0987	− 76	+1.7	+ .5	40 42 32.21	− 6 9.45	+ 15	+ 34	−10	5	23.20	66.5
	IV 1	R	19.3670	21.0837	+ 3	+ .8	+ .7	40 37 5.98	− 43.41	+ 2	+ 22	− 1	13	22.93	65.0
	2		21.9633	20.7980	+ 14	+1.0	+ .8	40 36 52.16	− 29.50	+ 1	+ 26	− 1	11	23.03	
	3		28.8673	12.4997	+ 95	− .4	− .1	40 29 28.93	+ 6 54.05	− 16	− 8	+13	7	22.94	
	4		18.6707	23.9163	+ 59	+ .3	+ .5	40 38 34.89	− 2 12.77	+ 5	+ 11	− 4	10	22.34	
	5		29.5373 IV	12.6963 II	− 30	− .4	+ .1	40 29 15.69	+ 7 5.70	+1.36	− 5	+12	6	22.88	64.7
	6		10.9470 II	30.2057 IV	− 8	+2.9	+2.2	40 28 14.11	+ 8 6.90	+1.34	+ 74	+13	5	23.27	
	7		27.8127 IV	12.9177 II	− 16	− .2	+ .4	40 30 4.62	+ 6 16.54	+1.38	+ 2	+11	6	22.73	
	8		13.0390	29.0953	+150	− .8	+ .1	40 43 9.54	− 6 46.32	+ 16	− 11	−12	7	23.22	64.1
	9		23.0193	19.6203	+ 37	+ .9	− .4	40 37 48.62	− 1 26.03	+ 3	+ 9	− 2	11	22.80	
	10		24.4920	15.2897	− 7	+2.1	+ .4	40 40 14.98	− 3 52.64	+ 9	+ 39	− 6	6	22.82	63.8
	11		34.9057 IV	7.2210 II	+ 71	−1.6	− .2	40 24 41.94	+11 40.11	+1.25	− 28	+21	6	23.29	63.1
Aug.	12		15.9587	27.9050	+201	− .1	+ .8	40 41 25.46	− 5 2.54	+ 12	+ 8	− 9	7	23.10	
23	III 1	R	28.1333	11.4700	− 26	+ .2	+1.3	40 43 23.60	− 7 1.22	+ 17	+ 19	−15	9	22.68	73.3
	2		8.0927 II	33.2430 IV	+ 30	+2.4	+1.9	40 46 59.87	−10 35.93	−1.28	+ 63	−24	11	23.16	72.6
	3		7.2037 II	31.4823 IV	− 26	+ .3	+1.7	40 26 7.91	+10 13.75	+1.29	+ 26	+18	5	23.44	
	4		7.8000 II	32 8870 IV	+ 16	+ .5	− .2	40 26 13.17	+10 9.02	+1.29	+ 6	+18	6	23.78	
	5		27.0850	16.3300	+160	− .2	−1.5	40 31 50.44	+ 4 32.32	− 11	− 20	+ 9	7	22.61	72.0
	6		18.0050	22.4987	+ 11	− .4	.0	40 38 16.05	− 1 53.64	+ 4	− 6	− 3	6	22.42	
	7		21.8583	19.4193	+ 14	+1.1	.0	40 37 24.17	− 1 1.70	+ 2	+ 18	− 2	6	22.71	
	8		17.3257	23.1223	+ 10	+ .8	+ .9	40 33 56.40	+ 2 26.58	− 6	+ 25	+ 4	6	23.27	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Aug.								° ′ ″						° ′ ″	°
23	III 9	R	12.4520	27.0793	— 30	—1.8	+ .1	40 42 32.47	— 6 9.74	15	— 27	—10	5	40 36 22.56	71.2
	IV 1	D	19.7363	18.0113	— 16	—1.1	—1.6	40 37 6.27	— 43.57	2	— 38	— 1	13	22.46	66.6a
	2		7.6880	18.8370	— 17	—3.0	—2.2	40 36 52.46	— 29.01	1	— 74	— 1	11	22.82	
	3		12.2017	28.5707	+ 56	— .0	— .6	40 29 29.25	+ 6 54.00	— 16	— 7	13	7	23.22	67.3a
	4		20.0033	14.7400	—121	+1.0	.0	40 38 35.20	— 2 12.76	5	+ 16	— 4	10	22.71	
	5		11.7493 II	28.5737 IV	— 4	— .5	— .8	40 29 16.03	+ 7 5.35	1.36	— 18	+ 12	6	22.74	66.7
	6		30.5110 IV	11.2427 II	— 4	— .6	+ .5	40 28 14.46	+ 8 7.14	1.34	— 3	+ 13	5	23.09	
	7		12.9800 II	27.8687 IV	— 20	— .2	—1.5	40 30 4.96	+ 6 16.37	1.38	— 22	+ 11	6	22.66	
	8		27.8597	11.7797	— 28	— .3	— 1.4	40 43 9.87	— 6 46.47	+ 16	— 22	—12	7	23.29	
	9		18.9597	22.3740	+ 29	— .0	+ .2	40 37 48.92	— 1 26.39	3	+ 2	— 2	11	22.67	
	10		14.9030	24.0693	— 39	—2.3	—1.3	40 40 15.31	— 3 51.65	9	— 53	— 6	6	23.22	65.8
Aug	12		26.0000	14.0007	0	+ .3	— .3	40 41 25.77	— 5 3.37	+ 12	+ 1	— 9	7	22.51	65.6
24	III 1	D	12.8563	29.5183	+173	+1.6	+1.1	40 43 23.71	— 7 1.69	+ 17	+ 40	—15	9	22.53	74.7
	2		31 8997 IV	6.7180 II	— 33	+2.5	+2.9	40 47 0.00	—10 36.57	—1.28	+ 77	—24	11	22.79	74.4
	3		31.6080 IV	7.3550 II	— 20	— .3	+ .8	40 26 8.08	+10 13.12	+ 1.29	— 5	+18	5	22.77	
	4		31.6063 IV	7.5380 II	— 17	+ 1.1	+1.8	40 26 13.37	+10 8.46	+ 1.29	+ 40	+ 18	6	23.76	74.1
	5		14.5813	25.3637	— 0	+ .4	+ .1	40 31 50.63	+ 4 32.60	— 11	+ 8	+ 9	7	23.36	
	6		22.3337	17.8407	+ 3	+ .9	+ .3	40 38 16.26	— 1 53.60	+ 4	+ 18	— 3	6	22.91	73.5
	7		18.3140	20.7673	— 10	+ .5	— .1	40 37 24.40	— 1 2.00	+ 2	+ 6	— 2	6	22.52	
	8		23.1857	17.4027	+ 15	+ .7	+1.0	40 33 56.64	+ 2 26.25	— 6	+ 24	+ 4	6	23.17	
	9		27.9497	13.3253	+ 49	+ .5	—1.1	40 42 32.72	— 6 9.86	+ 15	— 6	—10	5	22.90	72.4
	IV 2	R	22.6253	21 4583	+ 21	—2.1	—1.7	40 36 52.76	— 29.56	+ 1	— 55	— 1	11	22.76	68.7
	3		30.6687	14.3540	+355	— .9	+ .2	40 29 29.59	+ 6 53.38	— 16	— 12	+ 13	7	22.89	
	4		18.2820	23.5193	+ 42	— .6	— .8	40 38 35.51	— 2 12.52	+ 5	— 20	— 4	10	22.90	
	5		28.0990 IV	11.2923 II	+ 11	—1.4	— .7	40 29 16.37	+ 7 4.94	+ 1.36	— 31	+ 12	6	22.54	68.1
	6		9.9420 II	29.1893 IV	+ 3	+1.2	+ .1	40 28 14.81	+ 8 6.62	+ 1.34	+ 21	+ 13	5	23.16	
	7		27.1663 IV	12.2910 II	+ 12	— .4	.0	40 30 5.30	+ 6 16.11	+ 1.38	— 6	+ 11	6	22.90	
	8		13.0170	29.0863	+148	— .7	— .8	40 43 10.21	— 6 46.64	+ 16	— 22	—12	7	23.46	
	9		22.2937	18.8887	+ 18	.0	— .5	40 37 49.23	— 1 26.13	+ 3	— 6	— 6	11	23.12	68.2
	10		23.8577	14.6477	— 60	+ .4	— .4	40 40 15.65	— 3 52.70	+ 9	+ 1	— 6	6	23.05	67.4
	11		35.2723 IV	7.6217 II	+ 97	— .8	— .6	40 24 42.59	+11 39.32	+ 1.25	— 20	+ 20	6	23.22	
Aug.	12		14.2130	26.2167	+ 21	— .5	— .7	40 41 26.10	— 5 8.53	+ 12	— 17	— 9	7	22.50	67.6
31	III 1	R	27.7403	11.0697	— 85	— .2	— .2	40 43 24.07	— 7 1.26	+ 17	— 6	—15	9	22.86	67.5
	2		8.4453 II	33.6010 IV	+ 47	+ .1	— .6	40 47 0.51	—10 36.11	—1.28	— 6	—24	11	22.93	
	3		7.0267 II	31.2607 IV	— 33	+ 1.0	+ .8	40 26 8.81	+10 12.61	+ 1.29	+ 26	+ 18	6	23.21	66.6
	4		7.8543 II	31.8903 IV	— 6	— .5	.0	40 26 14.15	+10 7.67	+ 1.29	— 8	+ 18	6	23.27	
	5		25.5117	14.7747	+ 13	— .3	— .4	40 31 51.31	+ 4 31.49	— 11	— 10	+ 9	7	22.75	65.8
	6		18.0173	22.5273	+ 11	—2.2	— .8	40 38 17.32	— 1 54.05	+ 4	— 45	— 3	6	22.89	
	7		21.6737	19.1957	+ 9	+ .4	.3	40 37 25.55	— 1 2.67	+ 2	+ 2	— 2	6	22.96	
	8		18.0467	23.7863	+ 47	—1.1	— .1	40 33 57.88	+ 2 25.23	— 6	— 19	+ 4	6	22.96	
	9		11.2697	25.9717	—176	—1.5	+ .3	40 42 34.04	— 6 11.26	+ 15	— 20	—10	5	22.68	65.0
	IV 1	D	19.9543	18.1503	— 15	+ 2.5	+1.3	40 37 8.21	— 45 57	+ 2	+ 57	— 2	14	23.35	63.4
	2		25.6217	26.8560	+ 67	—1.8	— .2	40 36 54.51	— 31.38	+ 1	— 31	— 1	11	22.93	64.1
	3		10.6157	26.9010	—178	+ 1.5	+ .3	40 29 31.55	6 51.28	— 16	+ 27	+13	7	23.14	
	4		21.8007	16.4523	— 41	+ 2.3	+ .5	40 38 37.39	— 2 15.12	+ 5	+ 45	— 4	10	22.83	
	5		10.9693 II	27.6527 IV	+ 20	2.2	+1.1	40 29 18.48	+ 7 1.85	+ 1.36	+ 49	+ 12	6	22.36	62.6
	6		29.3487 IV	10.1833 II	1	—1.6	— .8	40 28 16.96	+ 8 4.55	+ 1.34	— 36	+13	5	22.67	
	7		13.8613 II	28.6527 IV	— 59	+ .8	+ .9	40 30 7.47	+ 6 13.81	+ 1.38	+ 24	+ 11	6	23.07	
	8		27.8860	11.6933	— 30	+ 1.4	+ .1	40 43 12.32	— 6 49.31	+ 16	+ 24	—12	7	23.36	
	9		18.9963	22.4960	+ 24	+ 1.2	+ .6	40 37 51.12	— 1 28.54	+ 3	+ 27	— 2	11	22.97	
	10		15.5987	24.8900	+ 19	— .3	+ .5	40 40 17.84	— 3 54.95	+ 9	+ 1	— 6	6	22.99	62.0
	11		6.1707 II	33.7533 IV	— 2	+ .1	— .3	40 24 44.73	+11 37.35	+1.25	— 2	+ 21	6	23.58	
Sep.	12		25.7873	13.6817	— 29	— .1	+ .1	40 41 28.20	— 5 5.98	+ 12	— 0	— 9	7	22.32	62.3
7	III 1	D	13.9473	30.6133	+ 332	+ .7	+ 2.5	40 43 24.58	— 7 2.19	+ 17	+ 43	—15	9	22.93	70.8
	2		32.4370 IV	7.2417 II	— 7	.3	.2	40 47 1.17	—10 36.98	—1.28	+ 7	—24	11	22.85	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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Sep. 7	III 3	D	30.7803 iv	6.5717 ii	— 50	— .6	— .5	40 26 9.66	+10 11.92	+1.20	— 16	+17	5	40 36 22.84	71.0
	5		11.9290	22.6340	—254	+1.1	+ .2	40 31 52.50	+ 4 30.00	— 11	+ 20	+ 9	7	22.75	
	6		22.7270	18.1380	+ 15	+1.2	+1.1	40 38 18.46	— 1 56.06	+ 4	+ 33	— 3	6	22.80	71.1
	7		18.4030	20.9327	— 8	—1.3	— .6	40 37 26.78	— 1 3.94	+ 2	— 28	— 2	6	22.62	
	8		22.8053	17.1180	— 2	+ .1	+ .5	40 33 59.19	+ 2 23.78	— 6	+ 8	+ 4	6	23.09	
Sep. 9			26.8513	12.1027	— 68	+ .7	— .3	40 42 35.42	— 6 12.71	+ 15	+ 7	—11	5	22.87	71.0
11	III 1	R	28.1467	11.4837	— 27	—2.3	—1.9	40 43 24.61	— 7 1.21	+ 17	— 61	—15	9	22.90	64.8
	2		7.8913 ii	33.0983 iv	+ 23	— .4	.0	40 47 1.29	—10 37.35	—1.19	— 6	—25	11	22.55	
	3		8.3240 ii	32.5363 iv	+ 15	— .3	— .4	40 26 9.88	+10 12.18	+1.20	— 10	+17	5	23.38	63.9
	4		8.7213 ii	32.7473 iv	+ 26	—2.0	—2.2	40 26 15.25	+10 7.50	+1.20	— 60	+18	6	23.59	
	5		26.4003	15.7207	+ 98	—1.2	— .5	40 31 52.83	+ 4 30.25	— 11	— 26	+ 9	7	22.87	62.6
	6		18.1220	22.7227	+ 17	+ .6	+1.7	40 38 18.87	— 1 56.36	+ 4	+ 31	— 3	6	22.89	
	7		21.0457	18.5020	— 6	—1.4	—1.5	40 37 27.26	— 1 4.30	+ 2	— 41	— 2	6	22.61	61.5
	8		16.8167	22.4777	— 18	—1.4	— .8	40 33 59.72	+ 2 23.08	— 6	— 22	+ 4	6	22.62	61.5
	9		13.3840	28.1737	+103	+1.6	+3.2	40 42 36.01	— 6 14.18	+ 15	+ 66	—10	5	22.59	
	IV 1	R	19.5327	21.1143	+ 2	.0	.0	40 37 10.72	— 47.58	+ 2	0	— 2	13	23.27	57.8
	2		21.3173	19.9573	+ 6	— .1	.0	40 36 57.18	— 34.40	+ 1	— 1	— 1	11	22.88	
	3		29.3183	13.1633	+175	—1.1	— .4	40 29 34.53	+ 6 48.88	— 16	— 23	+13	7	23.22	58.2
	4		17.8467	23.2963	+ 28	— .1	— .2	40 38 40.23	— 2 17.85	+ 5	— 4	— 5	10	22.44	
	5		28.0847 iv	11.4720 ii	+ 7	— .7	—1.1	40 29 21.66	+ 7 0.02	+1.27	— 25	+12	6	22.88	
	6		10.1067 ii	29.1340 iv	+ 12	+ .9	— .1	40 28 20.21	+ 8 1.08	+1.25	+ 13	+13	5	22.85	57.2
	7		27.2463 iv	12.5837 ii	+ 4	—1.4	.0	40 30 10.77	+ 6 10.71	+1.29	— 22	+10	6	22.71	
	8		12.1304	28.4037	+ 38	— .9	+ .1	40 43 15.51	— 6 51.52	+ 16	— 11	—12	7	23.99	
	9		23.1643	19.5677	+ 42	— .4	+ .2	40 37 53.98	— 1 31.04	+ 3	— 4	— 3	11	23.01	
	10		24.8663	15.4423	+ 18	+2.1	— .1	40 40 21.12	— 3 58.29	+ 9	+ 33	— 7	6	23.24	57.8
	11		33.6713 iv	6.2220 ii	— 2	— .7	.0	40 24 47.93	+11 33.98	+1.16	— 11	+20	6	23.22	
Sep. 12	12		14.6940	26.9157	+ 85	+1.9	+1.9	40 41 31.35	— 5 9.21	+ 12	+ 54	—10	7	22.77	58.4
12	III 1	D	13.2550	29.9187	+229	+ .3	+ .2	40 43 24.59	— 7 1.88	+ 17	+ 7	—15	9	22.89	62.5
	2		32.4533 iv	7.2647 ii	— 6	+ .3	+ .9	40 47 1.28	—10 36.81	—1.19	+ 16	—25	11	23.30	
	3		32.0240 iv	7.8063 ii	— 4	—2.0	—2.2	40 26 9.90	+10 12.27	+1.20	— 60	+17	5	22.99	62.1
	4		31.2757 iv	7.2857 ii	— 27	— .3	— .6	40 26 15.27	+10 6.45	+1.20	— 12	+18	6	23.04	
	6		21.4783	16.8743	— 34	+ .9	+ .3	40 38 18.94	— 1 56.31	+ 4	+ 24	— 3	6	22.94	61.3
	7		18.4243	20.9777	— 8	—1.1	— .5	40 37 27.34	— 1 4.54	+ 2	— 24	— 2	6	22.62	
	8		22.7877	17.1267	— 2	+1.1	— .1	40 33 59.81	+ 2 23.12	— 6	+ 16	+ 3	6	23.12	
	9		25.9970	11.2190	—110	+1.2	— .1	40 42 36.11	— 6 13.17	+ 15	+ 18	—10	5	23.22	61.4
	IV 1	D	20.3370	18.4220	— 12	+1.3	+ .1	40 37 10.89	— 48.39	+ 2	+ 22	— 4	13	22.83	60.8
	2		18.9130	20.2737	— 4	—2.4	—1.9	40 36 57.36	— 34.39	+ 1	— 63	— 1	11	22.45	
	3		12.0733	28.2203	+ 20	+ .3	—1.8	40 29 34.74	+ 6 48.28	— 16	— 17	+13	7	22.89	60.6
	4		21.5480	16.0823	— 59	+ .5	— .2	40 38 40.44	— 2 18.04	+ 5	+ 5	— 3	10	22.57	
	5		11.1020 ii	27.6857 iv	+ 27	+ .4	— .1	40 29 21.90	+ 6 59.34	+1.27	+ 5	+12	6	22.74	60.5
	6		29.5483 iv	10.5127 ii	0	— .4	— .1	40 28 20.46	+ 8 1.26	+1.25	— 8	+13	5	23.07	60.4
	7		12.3910 ii	27.0537 iv	+ 12	—1.6	—2.2	40 30 11.02	+ 6 10.74	+1.29	— 58	+10	6	22.68	
	8		26.4833	10.1647	—238	— .5	—1.5	40 43 15.75	— 6 51.97	+ 16	— 27	—12	7	23.62	
	9		17.8927	21.5347	— 10	+1.8	+1.9	40 37 54.20	— 1 32.05	+ 3	+ 53	— 3	11	22.79	
	10		14.8863	24.3323	— 31	+ .8	+ .2	40 40 21.39	— 3 58.74	+ 9	+ 15	— 7	6	22.88	59.6
	11		5.9343 ii	33.3563 iv	— 24	+1.6	+1.2	40 24 48.19	+11 33.23	+1.16	+ 41	+20	6	23.25	
Sep.	12		25.3267	13.0857	— 85	+1.9	+1.8	40 41 31.59	— 5 9.27	+ 12	+ 53	—10	7	22.94	60.0
15	III 2	R	10.0993 ii	35.2947 iv	+123	+1.3	+ .5	40 47 1.32	—10 37.31	—1.19	+ 27	—25	11	22.95	76.0
	3		8.1270 ii	32.3433 iv	+ 8	—2.4	—2.8	40 26 10.00	+10 12.26	+1.20	— 74	+17	5	22.94	
	4		8.6090 ii	32.5770 iv	+ 21	1.3	2.0	40 26 15.39	10 6.02	1.20	46	18	6	23.31	
	5		26.3870	15.7417	+ 99	+1.6	+1.6	40 31 53.04	+ 4 29.39	— 11	+ 46	+ 9	7	22.94	75.6
	6		18.5173	23.1330	+ 33	+ .2	+ .1	40 38 19.16	— 1 56.78	+ 4	+ 4	— 3	6	22.49	
	7		21.9403	19.3517	+ 14	+1.4	+ .5	40 37 27.60	— 1 5.49	+ 2	+ 29	— 2	6	22.46	75.2
	8		18.3907	24.0507	+ 60	—1.7	—1.8	40 34 0.10	+ 2 23.25	— 6	— 50	+ 3	6	22.88	
	9		12.3580	27.1643	— 39	+ .3	+ .8	40 42 36.44	— 6 14 24	+ 15	+ 15	—10	5	22.45	74.9

1894	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. C	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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Sep. 15	IV 1	R	19.2837	21.2160	− 2	−1.4	+1.7	40 37 11.39	− 48.86	2	+ 44	− 4	13	40 36 23.08	72.4
	2		21.1520	19.7447	+ 4	1.6	+2.2	40 36 57.90	− 35.59	1	53	− 1	11	22.95	
	3		26.5633	10.4297	−211	.7	+1.4	40 29 35.36	6 47.36	− 16	29	−13	7	23.05	71.8
	4		17.3127	22.7840	+ 3	− .4	.1	40 38 41.03	− 2 18.33	+ 5	− 5	− 3	10	22.77	
	5		27.9283 iv	11.3793 ii	+ 11	.9	.8	40 29 22.58	+ 6 58.42	1.27	24	12	6	22.69	
	6		9.4767 ii	28.4887 iv	+ 8	.2	− .4	40 28 21.16	8 0.69	1.25	− 2	13	5	23.26	70.9
	7		27.0147 iv	12.4215 ii	13	.2	2.0	40 30 11.73	6 8.99	1.29	28	10	6	22.45	
	8		12.2427	28.5840	+ 59	.9	1.1	40 43 16.45	− 6 53.29	16	29	−12	7	23.56	
	9		22.3160	18.7053	+ 15	.1	−1.7	40 37 54.82	− 1 31.34	3	− 28	− 3	11	23.31	69.9
	10		25.1927	15.7203	− 4	+1.7	.8	40 40 22.12	− 3 59.58	9	37	− 7	6	22.99	
	11		33.3290 iv	5.9210 ii	− 26	− .5	.3	40 24 48.91	11 32.87	1.16	− 4	20	6	23.16	
Oct. 2	12		14.0213	26.2703	15	.3	1.2	40 41 32.32	− 5 9.72	12	20	−10	7	22.89	70.9
	IV 1	D	21.0260	18.9793	0	1.9	1.2	40 37 14.45	− 51.75	1	45	− 2	13	23.27	62.5
	2		19.5810	21.1090	+ 2	− .3	.0	40 37 1.22	− 38.74	1	− 5	− 1	11	22.54	
	3		11.5617	27.5290	− 63	+2.2	.3	40 29 39.09	6.43.53	− 9	39	−13	7	23.12	
	4		22.1723	16.5310	− 34	−1.0	− .2	40 38 44.64	− 2 22.54	3	− 18	− 5	10	22.00	
	5		11.0813 ii	27.4760 iv	+ 24	1.1	.1	40 29 26.67	6 54.56	1.35	20	+12	6	22.96	61.2
	6		30.3110 iv	11.4707 ii	− 8	−1.2	− .9	40 28 25.41	7 56.31	1.33	− 31	13	5	22.92	
	8		28.0077	11.4903	− 38	1.2	− .4	40 43 20.71	− 6 57.50	10	14	−12	7	23.40	60.4
	9		16.8470	20.6203	− 43	.6	.1	40 37 58.69	− 1 35.29	2	8	− 3	11	23.58	
	10		13.9120	23.5433	−107	−1.4	− .1	40 40 26.63	− 4 3.24	6	− 24	− 7	6	23.20	59.5
	11		6.5083 ii	33.7637 iv	+ 7	−1.2	−2.2	40 24 53.34	11 29.10	1.29	− 47	+20	6	23.52	
Oct. 5	12		26.0523	13.6360	− 19	+1.1	1.3	40 41 36.71	− 5 13.86	7	− 34	−10	7	23.23	59.2
	IV 1	R	19.7177	21.7777	+ 13	.2	−1.1	40 37 15.00	− 52.11	1	− 11	− 2	13	22.90	55.9
	2		21.7903	20.2680	13	−1.3	−1.3	40 37 1.79	− 38.52	1	− 37	− 1	11	23.01	
	3		29.1410	13.2200	163	.0	1.6	40 29 39.74	6 42.93	− 9	20	13	7	22.98	55.8
	4		18.6387	24.2823	73	− .8	− .2	40 38 45.29	− 2 22.87	3	− 15	− 5	10	22.35	55.6
	5		27.0713 iv	10.7130 ii	+ 34	.7	.4	40 29 27.39	6 53.66	1.35	16	12	6	22.74	
	6		10.1770 ii	28.9837 iv	+ 4	.8	− .4	40 28 26.16	7 55.49	1.33	8	13	5	23.24	55.2
	7		26.8337 iv	12.4183 ii	19	− .2	− .1	40 30 16.77	6 4.50	1.36	− 4	10	6	22.75	
	8		12.0500	28.5807	46	−1.5	− .6	40 43 21.45	− 6 58.05	10	− 31	−12	7	23.14	55.0
	9		22.3637	18.5620	+ 17	− .9	− .2	40 37 59.39	− 1 36.16	2	− 17	− 3	11	23.16	
	10		24.2937	14.6303	− 46	.8	1.5	40 40 27.43	− 4 4.20	+ 6	32	− 7	6	23.60	54.4
	11		33.1350 iv	5.9400 ii	− 30	.0	.6	40 24 54.14	11 27.48	1.29	8	20	6	23.25	
	12		14.2133	26.6460	+ 47	−1.1	.0	40 41 37.51	− 5 14.45	7	18	−10	7	23.28	54.9
Oct. 6	IV 1	D	19.2977	17.1927	− 32	2.9	+2.4	40 37 15.15	− 53.14	1	77	− 2	13	22.90	
	2		17.7310	19.2710	− 20	1.5	−1.1	40 37 1.96	− 38.88	+ 1	− 38	− 1	11	22.81	
	3		12.5567	28.5027	72	1.7	.6	40 29 39.94	6 43.33	− 9	35	13	7	23.73	53.3
	4		21.8577	16.2153	− 48	− .3	− .7	40 38 45.49	− 2 22.53	3	− 14	− 5	10	22.90	53.3
	5		12.5103 ii	28.8947 iv	− 23	1.3	− .9	40 29 27.61	6 54.18	1.35	9	12	6	23.41	
	6		29.3140 iv	10.5163 ii	0	+ .1	+ .2	40 28 26.39	7 55.25	1.33	− 4	13	5	23.19	
	7		12.8693 ii	27.2837 iv	− 5	1.1	− .2	40 30 17.01	6 4.42	1.36	15	10	6	23.10	52.1
	8		27.0770	10.4933	−176	2.0	1.1	40 43 21.70	− 6 58.83	10	46	−12	7	23.38	
	9		17.9880	21.8317	− 3	+ .6	+ .6	40 37 59.62	− 1 37.17	2	17	− 3	11	22.72	51.1
	10		15.2120	24.9013	4	.0	+ .4	40 40 27.69	− 4 4.98	6	5	− 7	6	22.81	
	11		6.5387 ii	33.7447 iv	+ 8	− .6	.5	40 24 54.40	11 27.85	1.29	− 3	20	6	23.77	
	12		25.5140	13.0583	− 77	− .7	−2.2	40 41 37.77	− 5 14.71	7	− 39	−10	7	22.71	51.0
I	1	D	27.2237	12.2463	− 38	−2.0	−1.9	40 42 42.19	− 6 18.57	9	− 56	−13	8	23.10	46.7
	2		22.3747	17.8957	7	− .9	− .4	40 34 30.26	1 53.26	− 3	− 19	+ 4	9	23.43	
	3		27.3663	13.4797	56	− .2	− .2	40 42 14.47	− 5 51.23	+ 8	− 5	−10	6	23.23	
	4		18.6440	21.8163	5	− .3	1.8	40 37 43.15	− 1 20.22	2	17	− 3	7	23.16	47.0
	5		16.5987	25.2990	71	.0	+ .1	40 32 43.47	3 40.14	− 5	1	7	7	23.71	46.7
	6		23.8817	16.7483	26	−1.6	−1.8	40 33 23.22	+ 3 0.41	− 4	− 48	+ 5	6	23.22	
	7		27.4460	11.6737	− 60	3	+ 1.0	40 43 2.23	− 6 38.61	+ 9	17	−12	7	23.83	
	8		22.8757	16.0973	− 30	− .3	.0	40 33 32.02	+ 2 51.30	− 4	− 5	+ 5	6	23.34	46.6

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
								° ′ ″						° ′ ″	°
Oct. 11	IV 1	R	18.7487	20.8370	— 5	+2.4	+1.1	40 37 15.68	— 52.78	+ 1	+ 53	— 2	13	40 36 23.55	51.4
	2		21.2057	19.6507	+ 4	— .8	—1.4	40 37 2.56	— 39.32	+ 1	— 30	— 1	11	23.05	
	3		27.2717	11.3383	— 93	— .4	—1.4	40 29 40.66	+ 6 42.60	— 9	— 24	+12	7	23.12	51.3
	4		17.6803	23.3550	+ 29	— .7	+1.2	40 38 46.21	— 2 23.54	+ 3	+ 5	— 5	10	22.80	
	5		27.7093 iv	11.3823 ii	+ 15	+ .8	+ .1	40 29 28.46	+ 6 52.82	+1.35	+ 14	+12	6	22.95	50.0
	I 1	R	12.9483	27.9597	+ 60	+3.1	+1.4	40 42 42.55	— 6 19.67	+ 9	+ 68	—13	8	23.60	43.5
	2		17.8587	22.2973	+ 4	+ .8	+ .5	40 34 30.55	+ 1 52.23	— 3	+ 19	+ 2	9	23.05	
	3		11.7957	25.7570	—149	— .7	+ .9	40 42 14.94	— 5 52.60	+ 8	— 0	—10	6	22.38	
	4		23.0567	19.8817	+ 42	+ .8	+ .7	40 37 43.35	— 1 20.38	+ 2	+ 22	— 3	7	23.25	44.6
	5		24.6593	15.9717	+ 27	1.1	+ .7	40 32 43.61	+ 3 39.71	— 5	— 9	+ 7	7	23.32	44.8
	6		17.0263	24.1790	+ 39	—1.5	—2.3	40 33 23.30	+ 3 0.93	— 4	— 53	+ 5	6	23.77	
	7		11.7543	27.5480	— 50	+ .4	+ .8	40 43 2.26	— 6 39.17	+ 9	+ 16	—12	7	23.29	44.4
	8		17.0427	23.8280	+ 25	+ .2	— .8	40 33 31.94	+ 2 51.61	— 4	— 7	+ 5	6	23.55	43.4
	9		16.8423	21.8067	— 29	+ .7	+1.2	40 38 28.22	— 2 5.44	+ 3	+ 26	— 4	7	23.10	
	10		31.0603 iv	9.2710 ii	+ 2	+ .6	+1.6	40 27 10.46	+ 9 10.87	+1.32	+ 32	+20	9	23.26	44.2
Oct. 15	IV 1	D	20.9443	18.8573	0	— .4	—1.3	40 37 16.10	— 52.76	+ 1	— 23	— 2	13	23.23	46.6
	2		18.6217	20.1937	— 8	—2.3	—2.0	40 37 3.03	— 39.72	+ .1	— 62	— 1	11	22.80	
	3		11.8283	27.7453	— 30	+ .4	+ .1	40 29 41.21	+ 6 42.34	— 9	+ 7	+12	7	23.72	46.2
	4		22.1020	16.3783	— 39	.0	.0	40 38 46.76	— 2 24.61	+ 3	0	— 5	10	22.23	
	5		11.6343 ii	27.9550 iv	+ 7	0	— .2	40 29 29.09	+ 6 52 64	+1.35	— 2	+12	6	23.24	
	6		29.2757 iv	10.5260 ii	+ 1	—1.2	— .6	40 28 27.97	+ 7 54.04	+1.33	— 27	+13	5	23.25	45.8
	7		13.4077 ii	27.7573 iv	— 31	1.0	.5	40 30 18.64	+ 6 2.71	1.36	— 22	+10	6	23.09	45.6
	9		16.8700	20.7623	— 40	— .1	.4	40 38 1.15	— 1 38.31	+ 2	— 6	— 3	11	22.88	45.4
	10		15.0147	24.7497	— 10	—2.1	— .4	40 40 29.52	— 4 6.10	+ 6	— 39	— 7	6	23.08	45.2
	11		6.8567 ii	33.9840 iv	+ 26	— .2	—1.0	40 24 56.22	+11 25.91	+1.29	— 15	+20	6	23.53	
Oct. 16	12		25.3320	12.7780	—105	+ .4	.0	40 41 39.61	— 5 17.13	+ 7	+ 5	—10	7	22.57	45.1
	IV 1	R	18.3093	20.4517	— 11	+3.8	+3.3	40 37 16.24	— 54.14	+ 1	+1.03	— 2	13	23.25	53.3
	2		19.6683	18.0703	— 15	+ .2	— .4	40 37 3.18	— 40.36	+ 1	— 2	— 1	11	22.91	
	3		28.2763	12.4290	+ 49	+1.8	+ .8	40 29 41.37	+ 6 40.78	— 9	+ 39	+12	7	22.64	53.1
	4		17.1200	22.8723	0	+1.3	+1.4	40 38 46.92	— 2 25.43	+ 3	+ 39	— 5	10	21.96	
	5		26.1423 iv	9.8870 ii	+ 63	+1.5	+2.4	40 29 29.28	+ 6 51.13	+1.35	+ 54	+12	6	22.48	
	6		10.4490 ii	29.1777 iv	— 1	+1.4	.0	40 28 28.17	+ 7 53.50	+1.33	+ 22	+13	5	23.40	51.9
	7		27.5913 iv	13.2743 ii	— 22	+1.2	+2.1	40 30 18.84	+ 6 1.91	+1.36	+ 46	+10	6	22.73	
	8		12.1680	28.8187	+ 72	+2.0	+2.6	40 43 23.55	— 7 1.15	+ 10	+ 65	—12	7	23.10	
	9		23.6167	19.7310	+ 57	+2.3	+1.4	40 38 1.34	— 1 38.38	+ 2	+ 54	— 3	11	23.60	54.5
	10		24.2357	14.4447	— 56	+2.0	+ .8	40 40 29.74	— 4 7.40	+ 6	+ 42	— 7	6	22.81	54.1
	11		33.1823 iv	6.0707 ii	— 23	— .4	— .6	40 24 56.44	+11 25.39	+1.29	— 14	+20	6	23.24	
	12		13.6500	26.1623	— 9	—1.6	— .8	40 41 39.83	— 5 16.32	+ 7	— 36	—10	7	23.19	54.4
	I 2	D	21.8697	17.4440	— 23	— .0	— .1	40 34 30.58	+ 1 51.83	— 3	— 1	+ 4	9	22.50	51.1
	3		26.6533	12.7870	— 36	+1.4	+ .8	40 42 14.95	— 5 51.74	+ 8	+ 32	—10	6	23.57	
	4		17.6877	20.8747	— 19	+1.5	+ .5	40 37 43.29	— 1 20.53	+ 2	+ 30	— 3	7	23.12	50.6
	5		15.3330	24.0327	— 26	+ .5	.0	40 32 43.49	+ 3 39.88	— 5	+ 8	+ 7	7	23.54	
	6		24.2603	17.1313	+ 45	— .7	— .4	40 33 23.12	+ 3 0.35	— 4	— 16	+ 5	6	23.38	
	7		27.3163	11.5537	— 80	— .2	+ .1	40 43 2.04	— 6 38.31	+ 9	— 1	—12	7	23.76	50.7
	8		23.7380	16.9630	+ 23	—1.4	.2	40 33 31.57	+ 2 51.35	4	— 25	+ 5	6	22.74	50.1
	9		21.9943	17.0833	— 20	—2.1	—1.9	40 38 27.84	— 2 4.11	+ 3	— 58	— 4	7	23.21	
Oct. 17	10		7.3300 ii	29.1480 iv	— 28	+ .4	— .1	40 27 10.04	+ 9 11.54	+1.32	+ 5	+20	9	23.24	50.4
	IV 1	D	19.2540	17.1227	— 34	+1.4	— .2	40 37 16.38	— 53.80	+ 1	+ 20	— 2	13	22.90	55.4
	2		18.2107	19.8133	— 13	— .5	+ .7	40 37 3.33	— 40.48	+ 1	+ 1	— 1	11	22.97	55.3
	3		10.6277	26.5067	—199	+1.5	+ .2	40 29 41.55	+ 6 40.95	— 9	+ 26	+12	7	22.86	53.6
	4		22.1593	16.4277	—138	— .4	+ .5	40 38 47.10	— 2 24.81	+ 3	0	— 5	10	22.37	
	5		10.5430 ii	26.8603 iv	+ 42	+ .2	+ .2	40 29 29.47	+ 6 52.65	+1.35	+ 5	+12	6	23.70	
	6		29.7867 iv	11.1103 ii	— 1	+2.4	+3.8	40 28 28.38	+ 7 52.18	+1.33	+ 87	+13	5	22.94	53.6
	7		13.3403 ii	27.6610 iv	— 25	+ .7	.0	40 30 19.05	+ 6 2.00	+1.36	+ 11	+10	6	22.68	
	8		26.9083	10.2633	—207	+1.6	—1.1	40 43 23.77	— 7 0.30	+ 10	+ 12	—12	7	23.64	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections: Micrometer.	Corrections: δ	Corrections: l	Corrections: r	Corrections: Mer	Latitude.	Ther. mom.
Oct.								° ′ ″						° ′ ″	
17	IV 9	D	17.2040	21.0947	— 31	— .7	— .3	40 38 1.54	— 1 38.29	— 2	— 7	— 3	11	40 36 23.42	53.4
	10		14.4263	24.1910	— 59	2.3	1.4	40 40 29.97	— 1 6.72	— 6	— 51	— 7	6	22.76	
	11		6.3003 II	33.4243 IV	— 9	— .8	— .8	40 21 56.67	11 25.73	1.29	— 23	— 20	6	23.72	52.9
	I 1	R	11.9907	26.9923	— 66	1.1	1.3	40 42 42.66	— 6 19.11	— 9	— 1	— 13	8	23.60	48.2
	2		18.5347	23.0023	— 29	— 2.5	— 2.3	40 31 30.59	— 1 53.03	— 3	— 70	— 4	9	23.02	
	3		13.5210	27.4170	+ 57	.9	1.1	40 42 14.95	— 5 51.47	— 8	— 28	— 10	6	23 24	
	4		24.4190	21.2703	— 80	— .4	— .1	40 37 13.28	— 1 19.81	— 2	— 1	— 3	7	23.54	48 8
	5		25.1053	16.3907	— 56	— 2.3	— 1.6	40 32 13.17	— 3 40.17	— 5	— 57	— 7	7	23.46	
	6		16.9923	24.1380	— 37	— 1.4	— 1.8	40 33 23.08	— 3 0.75	— 4	— 45	— 5	6	23.45	
	7		12.4377	28.1867	— 42	— 1.9	— 1.7	40 43 1.99	— 6 38.28	— 9	— 52	— 12	7	23.23	
	8		17.1107	23.9413	— 32	— 2.1	— 2.4	40 33 31.50	— 2 52.77	— 4	— 64	— 5	6	23.70	48.0
	9		18.9133	23.8220	— 60	— 2.1	— .4	40 38 27.75	— 2 4.25	— 3	— 39	— 4	7	23.17	
Oct.	10		32.1443 IV	10.5127 II	— 18	— .0	— .4	40 27 9.94	9 11.21	1.32	— 5	— 20	9	22.84	18 3
18	IV 1	R	19.8810	21.9920	— 17	— .0	— .8	40 37 16.52	— 53.41	— 1	— 10	— 2	13	23.13	50.8
	2		21.1630	19.5920	— 3	— 2.1	— 2.6	40 37 3.49	— 39.73	— 1	— 67	— 1	11	23.20	
	3		26.7913	10.8870	—160	— 2.8	— .8	40 29 41.72	6 11.69	— 9	— 55	+ 12	7	22.96	51.1
	4		17.5680	23.3100	— 22	— .3	— 1.2	40 38 17.28	— 2 25.23	— 3	— 10	— 5	10	22.23	
	5		27.5030 IV	11.2120 II	— 23	— 1.7	— 1.1	40 29 29.67	6 51.93	1.35	— 11	— 12	6	22.72	
	6		10.6953 II	29.4077 IV	— 1	— 1.3	— 1.2	40 28 28.59	7 53.09	1.33	— 36	— 13	5	23.55	50.2
	7		26.8287 IV	12.5067 II	— 18	— .9	— 1.0	40 30 19.27	6 2.14	1.36	— 27	— 10	6	22.66	50.5
	8		10.4610	27.1247	—189	— 1	— .9	40 43 23.98	— 7 0.84	— 10	— 5	— 12	7	23.24	
	9		19.8950	15.9607	— 70	— .8	— .3	40 38 1.75	— 1 39.29	— 2	— 17	— 3	11	22 73	
	10		24.3547	14.5537	— 46	— 1.6	— .2	40 40 30.22	— 4 7.68	— 6	— 28	— 7	6	22.87	19 1
	11		33.4680 IV	6.3570 II	— 6	— 1.3	— .0	40 21 56.91	11 25.11	1.29	— 21	— 20	6	23.66	
	12		13.6657	26.2183	— 5	— 1.0	— .4	40 41 40.30	— 5 18.10	— 7	— 21	— 10	7	22.45	49.6
	I 1	D	26.6807	11.6723	—109	— 1.9	— .9	40 42 42.73	— 6 19.17	— 9	— 41	— 13	8	23.19	12.7
	2		21.8540	17.4067	— 15	— .2	— .6	40 31 30.61	— 1 52.10	— 3	— 10	— 4	9	23.01	
	3		27.0443	13.1403	— 11	— 1.1	— .8	40 42 11.97	— 5 51.55	— 8	— 28	— 10	6	23.18	
	4		17.9960	21.1720	— 12	— .6	— .8	40 37 43.29	— 1 29.27	— 2	— 19	— 3	7	22.89	44.1
	5		15.6197	24.3363	— 4	— .1	— .3	40 32 43.45	— 3 40.37	— 5	— 2	— 7	7	23.89	
	6		23.8380	16.6900	— 15	— 1.6	— .4	40 33 23.06	— 3 0.76	— 4	— 31	— 5	6	23.58	
	7		27.2640	11.4847	— 90	— .8	— .3	40 43 1.96	— 6 38.71	— 9	— 9	— 12	7	23.38	43.6
	8		23.5877	16.7897	+ 11	— .9	— .5	40 33 31 43	— 2 51.90	— 4	— 21	— 5	6	23.19	43.5
	9		22.9700	18.0207	— 22	— 1.3	— 1.4	40 38 27.67	— 2 5.19	— 3	— 38	— 4	7	22.92	
	10		9.3767 II	31.2183 IV	— 2	— .5	— .6	40 27 9.86	— 9 12.21	1.32	— 15	— 20	9	23.83	13.7
Oct.															
19	IV 1	D	19.8913	17.7620	— 22	— .7	— .6	40 37 16.66	— 53.78	— 1	— 19	— 2	13	23.19	54.0
	2		19.0630	20.6893	— 1	— .3	— .9	40 37 3.63	— 41.11	— 1	— 16	— 1	11	22.79	
	3		11.7173	27.6123	— 46	— 1.0	— 1.7	40 29 41.89	— 6 41.75	— 9	— 37	— 12	7	23.37	53 7
	4		21.8233	16.0950	— 53	— 1.1	— .7	40 38 47.45	— 2 24.69	— 3	— 27	— 5	10	22.57	
	5		10.5080 II	26.7997 IV	— 11	— .3	— .7	40 29 29.86	— 6 52.00	1.35	— 11	— 12	6	23.25	
	6		29.4677 IV	10.7460 II	— 1	— 2.6	— 2.6	40 28 28.79	— 7 53.33	1.33	— 75	— 13	5	22.88	
	7		13.0933 II	27.4057 IV	— 12	— 2.3	— .7	40 30 19.48	— 6 1.82	1.36	— 46	— 10	6	23.28	53.6
	8		26.9190	10.2547	—206	— 1.7	— 1.2	40 43 21.21	— 7 0.79	— 10	— 12	— 12	7	23.89	
	9		18.2210	22.1420	— 6	— .1	— .7	40 38 1.96	— 1 39.15	— 2	— 7	— 3	11	22.98	
	10		15.2093	24.9830	— 7	— .6	— .9	40 40 30.46	— 4 7.12	— 6	— 2	— 7	6	23.41	52.7
	11		6.0197 II	33.1290 IV	— 28	— 1.2	— 1.3	40 24 57.14	+11 25.31	1.29	— 36	— 20	6	23.64	51 8
	12		24.8200	12.2390	—163	— .3	— 1.0	40 41 40.54	— 5 17.66	— 7	— 8	— 10	7	22.84	
	I 1	D	13.6887	28.6860	—155	— .2	— 1.8	40 42 42.79	— 6 19.56	— 9	— 25	— 13	8	23.02	47.2
	2		18.3917	22.8293	+ 23	— 2.4	— .0	40 31 30.65	— 1 52.25	— 3	— 39	— 4	9	22.61	
	3		12.5917	26.5497	— 52	— 1.6	— 2.3	40 42 15.01	— 5 52.76	— 8	— 55	— 10	6	22.84	
	1		22.4857	19.3277	— 26	— 1.1	— .3	40 37 43.31	— 1 19.91	— 2	— 14	— 3	7	23.60	17.2
	5		21 4110	15 7737	— 8	— .2	— 1.9	40 32 43.46	— 3 39.15	— 5	— 21	— 7	7	22.91	*
	6		17.0693	24.2067	+ 41	— .0	— .2	40 33 23.06	— 3 0.55	— 4	— 3	— 5	6	23.65	
	7		12.4567	28.2480	— 48	— .6	— .7	40 43 1.91	— 6 39.36	— 9	— 18	— 12	7	22.80	
	8		17.0087	23.8250	— 26	— .5	— .5	40 33 31.38	— 2 52.40	— 4	— 14	— 5	6	23.99	46.3

* Fog.

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Oct.								° ′ ″						° ′ ″	°
19	I 9	D	18.4800	23.4253	+ 43	— .1	+ .7	40 38 27.61	— 2 5.14	+ 3	+ 2	— 4	7	40 36 22.55	
Oct.	10		32.2237 iv	10.3930 ii	+ 19	— .2	+ .1	40 27 9.79	+ 9 11.98	+1.32	— 1	+20	9	23.37	46.5
20	IV 1	R	18.4223	20.5670	— 10	+ 3.0	+2.8	40 37 16.78	— 54.20	+ 1	+ 84	— 2	13	23.54	56.6
	2		21.4203	19.8217	+ 7	—1.4	—1.9	40 37 3.76	— 40.44	+ 1	— 46	— 1	11	22.97	57.2
	3		27.7563	11.9123	— 24	+ .3	+ 2.2	40 29 42.04	+ 6 40.51	— 9	+ 32	+12	7	22.97	
	4		16.0137	21.7887	— 56	+ 2.2	+ 2.4	40 38 47.61	— 2 25.86	+ 3	+ 65	— 5	10	22.48	56.6
	5		27.5390 iv	11.2890 ii	+ 22	+ 1.3	+ 2.2	40 29 30.04	+ 6 50.89	+1.35	+ 48	+12	6	22.94	
	6		10.7277 ii	29.4270 iv	— 1	+ .9	— .1	40 28 28.99	+ 7 52.76	+1.33	+ 11	+13	5	23.37	56.1
	7		26.7537 iv	12.4283 ii	+ 22	—1.8	—1.6	40 30 19.68	+ 6 2.23	+1.36	— 49	+ 10	6	22.94	
	8		11.3117	28.0290	— 47	.1	.2	40 43 21.41	7 1.77	+ 10	+ 1	—12	7	22.70	
	9		19.7777	15.8630	— 75	— .2	—1.9	40 38 2.16	— 1 38.78	+ 2	— 27	— 3	11	23.21	
	10		23.8960	14.0927	— 85	+ .4	— .2	40 40 30.68	— 4 7.63	+ 6	+ 4	— 7	6	23.14	55.3
	11		33.5497 iv	6.4677 ii	0	—1.5	—1.2	40 24 57.38	+11 24.70	+1.29	— 39	+ 20	6	23.24	
Oct.	12		12.7207	25.2953	—110	—1.6	—1.3	40 41 40.78	— 5 17.64	+ 7	— 42	—10	7	22.76	55.6
27	IV 1	D	20.8133	18.6567	— 6	+1.8	+ .9	40 37 17.20	— 54.51	+ 1	+ 40	— 2	13	23.21	52.8
	2		18.4993	20.1363	— 10	—1.4	.0	40 37 4.27	— 41.36	+ 1	— 22	— 1	11	22.80	
	3		12.0243	27.8617	— 8	+1.1	+1.4	40 29 42.68	+ 6 40.39	— 9	+ 35	+12	7	23.52	52.8
	4		21.0107	15.2290	— 96	+ .4	— .2	40 38 48.29	— 2 25.93	+ 3	+ 4	— 5	10	22.48	
	5		11.9883 ii	28.2360 iv	— 3	.0	.0	40 29 30.85	+ 6 50.77	+1.35	0	+12	6	23.15	
	6		29.5917 iv	10.9040 ii	— 2	—3.6	—2.7	40 28 29.90	+ 7 52.46	+1.33	— 92	+13	6	22.96	51.8
	8		28.2873	11.6147	— 8	—1.5	+ .6	40 43 25.41	— 7 1.50	+ 10	— 16	—12	7	23.80	
	9		17.4873	21.4603	— 19	+ .7	+ .7	40 38 3.13	— 1 40.40	+ 2	+ 20	— 3	11	23.03	
	10		14.9583	24.7967	— 8	—1.1	— .6	40 40 31.86	— 4 8.72	+ 6	— 25	— 7	6	22.94	51.0
	11		6.0717 ii	33.1213 iv	— 25	+ .2	— .4	40 24 58.57	+11 23.81	+1.29	— 2	+20	6	23.91	
	12		26.7823	14.1640	+ 51	+1.0	.0	40 41 42.00	— 5 19.15	+ 7	+ 16	—10	7	23.05	51.1
	I 1	D	26.7590	11.7193	—101	—1.7	—1.7	40 42 43.38	— 6 19.98	+ 9	— 49	—13	8	22.95	46.5
	2		21.7590	17.3460	— 18	— .9	— .1	40 34 31.13	+ 1 51.53	— 3	— 16	+ 4	9	22.60	
	3		26.8663	12.9467	— 10	+ .8	— .8	40 42 15.47	— 5 51.89	+ 8	+ 3	—10	6	23.65	
	4		17.8587	21.0327	— 16	—1.6	—1.5	40 37 43.66	— 1 20.21	+ 2	— 45	— 3	7	23.06	47.4
	5		14.8180	23.5267	— 63	— .6	—1.7	40 32 43.71	+ 3 40.02	— 5	— 31	+ 7	7	23.51	47.4
	6		23.6177	16.5017	+ 3	+ .6	+1.7	40 33 23.22	+ 2 59.93	— 4	+ 31	+ 5	6	23.52	
	7		27.1893	11.4120	— 99	+ .1	.0	40 43 2.02	— 6 38.64	+ 9	+ 1	—12	7	23.43	47.3
	8		24 0040	17.1900	— 25	—1.6	— .6	40 33 31.26	+ 2 52.36	— 4	— 33	+ 5	6	23.36	
	9		22.5163	17.5960	+ 2	— .6	—1.0	40 38 27.41	— 2 4.40	+ 3	— 22	— 4	7	22.85	
	10		8.9433 ii	30.7880 iv	— 1	+ .8	.0	40 27 9.51	+ 9 12.28	+1.32	+ 13	+20	9	23.53	47.5
Oct.															
31	I 1	R	12.1630	27.1953	— 44	+ .4	—1.9	40 42 43.50	— 6 19.94	+ 9	— 17	—13	8	23.43	44.4
	2		18.1217	22.5790	+ 14	—3.4	—2.7	40 34 31.16	+ 1 52.73	— 3	— 89	+ 4	9	23.10	
	3		13.4477	27.3847	+ 51	— .3	— .2	40 42 15.53	— 5 52.49	+ 8	— 7	—10	6	23.01	43.8
	4		23.2383	20.0747	+ 46	— .3	.0	40 37 43.66	— 1 20.10	+ 2	— 5	— 3	7	23.57	
	I 5		24.3683	15.6510	+ 2	—2.1	—1.1	40 32 43.66	+ 3 40.27	— 5	— 48	+ 7	7	23.54	
	6		17.0517	24.1627	+ 39	.0	.0	40 33 23.13	+ 2 59.88	— 4	— 0	+ 5	6	23.08	
	7		12.6243	28.3680	+ 69	—1.1	+ .2	40 43 1.88	— 6 38.21	+ .9	— 15	—12	7	23.56	44.4
	8		16.5780	23.4040	0	— .3	+ .5	40 33 31.02	+ 2 52.58	— 4	+ 1	+ 5	6	23.68	44.0
	9		18.3483	23.3003	+ 35	+ 1.1	+2.9	40 38 27.14	— 2 5.29	+ 3	+ 54	— 4	7	22.45	
	10		30.9620 iv	9.1067 ii	0	—1.9	— .6	40 27 9.20	+ 9 12.55	+1.32	— 38	+20	9	22.98	44.3
Nov															
1	IV 1	R	19.0290	21.2077	+ 1	+ .5	+1.4	40 37 17.61	— 55.08	+ 1	+ 26	— 2	13	22.91	54.7
	2		20.3817	18.7350	— 6	—2.3	—2.6	40 37 4.73	— 41.62	+ 1	— 70	— 1	11	22.52	
	3		29.2307	13.4530	+184	+ .8	+ 2.2	40 29 43.22	+ 6 39.36	— 9	+ 40	+12	7	23.08	53.8
	4		17.1203	22.9390	+ 0	+ 2.8	+2.2	40 38 48.86	— 2 27.11	+ 3	+ 77	— 5	10	22.60	
	5		28.2977 iv	12.1013 ii	— 6	+1.2	+1.4	40 29 31.49	+ 6 49.47	+1.35	+ 37	+12	6	22.86	
	6		11.0293 ii	29.6723 iv	— 3	— .4	—1.0	40 28 30.60	+ 7 51.33	+1.33	— 19	+13	5	23.25	52.4
	7		26.8330 iv	12.5660 ii	+ 16	—3.3	—1.2	40 30 21.38	+ 6 0.74	+1.36	— 68	+10	6	22.96	
	8		12.3820	29.0883	+106	—1.3	+ .2	40 43 26.17	— 72.64	+ 10	— 18	—12	7	23.40	
	9		22.4807	18.4973	+ 18	— .2	— .8	40 38 3.88	— 1 40.76	+ 2	— 13	— 3	11	23.09	
	10		24.6260	14.7630	— 25	— .4	— .4	40 40 32.72	— 4 9.30	+ 6	— 11	— 7	6	23.36	50.0

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. t	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Nov								° ′ ″						° ′ ″	°
1	IV 11	R	33.6240 iv	6.6430 ii	+ 7	- .5	+ .6	40 24 59.44	+ 11 22.16	1.29	0	+20	6	40 36 23.15	49.6
	12		13.7977	26.4350	— 14	-1.6	—1.8	40 41 42.89	— 5 19.54	+ 7	— 48	—10	7	22.91	
	I 1	R	26.4270	11.3890	—144	- .5	— .1	40 42 43.56	— 6 19.83	9	— 9	—13	8	23.68	43.1
	2		22.5570	18.1473	— 14	- .1	+ .4	40 34 31.23	+ 1 51.52	3	3	1	9	22.88	
	3		27.8083	13.8803	+103	-2.3	+ .3	40 42 15.57	— 5 52.39	8	+ 41	—10	6	23.63	
	4		18.7597	21.9597	+ 11	+ 2.0	+ 2.0	40 37 43.68	— 1 20.93	2	+ 58	— 3	7	23.39	44.4
	5		16 1647	24.8447	+ 38	-1.8	+1.9	40 32 43.63	+ 3 39.55	5	+ 53	+ 7	7	23.80	
	6		23.4480	16.3163	— 8	-1.2	— .2	40 33 28.13	+ 3 0.29	4	22	+ 5	6	23.27	
	7		27.1667	11.3977	—101	+ .6	+ .4	40 43 1.87	— 6 38.42	9	+ 14	—12	7	23.63	
	8		23.6860	16.8810	+ 18	+ .5	+1.5	40 33 30.98	+ 2 52.09	4	+ 27	+ 5	6	23.41	43.6
	9		22.2313	17.3107	— 11	.2	— .2	40 38 27.10	— 2 4.38	+ 3	— 5	— 4	7	22.73	
Nov	10		9.3563 ii	31.2167 iv	+ 3	.2	— .5	40 27 9.14	+ 9 12.69	1.32	— 9	+20	9	23.35	43.6
2	IV 1	D	20.7663	18.5827	— 6	.0	+ .7	40 37 17.68	— 55.19	1	+ 9	— 2	13	22.70	56.1
	2		18.9853	20.6827	— 1	+ 1.2	+2.2	40 37 4.81	— 42.91	1	+ 47	— 1	11	22.48	56.7
	3		11.6980	27.5053	— 56	+ .4	.0	40 29 43.31	+ 6 39.50	9	+ 6	+12	7	22.97	
	4		22.5277	16.7140	— 21	+ 1.7	+ .1	40 38 48.96	— 2 26.93	3	— 29	— 5	10	22.40	
	5		11.0477 ii	27.2483 iv	+ 42	+ .2	— .1	40 29 31.60	+ 6 49.69	1.35	+ 1	+ 12	6	22.83	56.4
	6		29.4847 iv	10 8627 ii	— 2	-1.5	+ .3	40 28 30.73	+ 7 50.80	1.33	+ 20	+13	5	22.84	55.9
Nov	7		12.3027 ii	36.5163 iv	+ 32	+ 1.9	— .1	40 30 21.51	+ 5 59.43	1.36	+ 29	+10	6	22.75	54.5
3	I 1	R	13.7553	28.7800	+176	+ .2	— .6	40 42 43.73	— 6 20.30	9	— 4	—13	8	23.43	46.2
	2		17.2840	21.7120	— 20	— .9	— .4	40 34 31.37	+ 1 51.90	— 3	— 19	+ 4	9	23.18	
	3		13.3600	27.3223	+ 42	+ 1.0	+ 1.7	40 42 15.71	— 5 53.11	8	— 37	—10	6	23.01	
	4		22.5883	19.4120	+ 28	— .4	+ .1	40 37 43.79	— 1 20.37	2	— 5	— 3	7	23.43	46.7
	5		24.5887	15.9013	+ 19	1.0	— .1	40 32 43.74	+ 3 39.69	5	— 17	+ 7	7	23.35	
	6		15.7460	23.8783	— 13	.8	—1.0	40 33 23.19	+ 3 0.29	— 4	— 25	+ 5	6	23.30	
	7		12.0590	27.8020	— 10	-2.1	+ 1.2	40 43 1.90	— 6 37.99	9	— 19	—12	7	23.76	46.5
	8		17.2560	24.0753	+ 40	.0	— .9	40 33 30.95	+ 2 52.51	4	— 11	+ 5	6	23.42	46.2
	9		17.6777	22.5763	+ 7	-1.0	—1.1	40 38 27.06	— 2 3.87	3	— 30	— 4	7	22.95	
Nov	10		32.5880 iv	10.7517 ii	+ 27	+ .6	+ 1.6	40 27 9.08	+ 9 12.14	1.32	— 29	+ 20	9	23.12	46.3
4	IV 1	R	20.4897	22.6463	+ 29	+ 1.7	—1.2	40 37 17.77	— 54.60	1	— 15	— 2	13	23.44	46.9
	2		21.3930	19.7500	+ 7	— .9	—1.2	40 37 4.91	— 41.56	1	— 29	— 1	11	23.17	
	3		26.7297	10.9213	—164	— .2	+ .3	40 29 43.45	+ 6 39.26	9	+ 1	+12	7	22.82	
	4		16.4310	22.2503	— 35	— .3	- .1	40 38 49.12	— 2 27.04	3	— 6	— 5	10	22.10	48.2
	5		28.0560 iv	11.8433 ii	+ 1	- .4	— .2	40 29 31.79	+ 6 49.90	1.30	— 9	+ 12	6	23.08	
	6		10.9720 ii	29.5777 iv	— 2	+ 2.2	+ 1.3	40 28 30.95	+ 7 50.39	1.28	+ 52	+13	5	23.32	47.4
	7		28.1050 iv	13.8593 ii	— 53	-1.0	— .6	40 30 21.75	+ 6 0.03	1.31	— 23	+10	6	23.02	
	8		12.2130	28.9467	+ 84	— .5	+ 1.0	40 43 26.58	— 7 3.28	10	— 4	—13	7	23.38	
	9		21.4627	17.4790	— 19	+ .3	—1.2	40 38 4.29	— 1 40.67	2	— 10	— 4	11	23.61	
	10		24.7540	14.8657	— 16	+ .9	+ .4	40 40 33.20	— 4 9.96	6	+ 19	— 7	6	23.48	46.5
	11		33.6510 iv	6.6647 ii	+ 10	—1.4	— .6	40 24 59.94	+11.22.30	1.24	— 30	+20	6	23.44	47.0
Nov	12		14.3747	27.0507	— 0	— .4	—1.2	40 41 43.41	— 5 20.68	7	— 21	—10	7	22.56	
6	I 1	D	27.2397	12.1557	— 45	+ .3	+ .3	40 42 44.05	— 6 21.24	9	+ 9	—13	8	22.94	33.4
	2		21.7817	17.3487	— 17	—3.0	—1.3	40 34 31.65	+ 1 52.03	3	— 65	+ 4	9	23.13	
	3		27.7473	13.8110	+ 95	— .6	—1.7	40 42 15.98	— 5 52.58	8	— 31	—10	6	23.13	33.1
	4		17.6000	20.8080	— 23	—1.6	— .2	40 37 44.03	— 1 21.05	2	— 28	— 3	7	22.76	
	5		15.0730	23.7437	— 44	+ 1.7	+ 1.4	40 32 43.95	+ 3 39.10	5	+ 45	+ 7	7	23.59	33.1
Nov	6		23.6417	16.5170	+ 5	— .8	— .1	40 33 23.37	+ 3 0.14	— 4	— 14	+ 5	6	23.44	
10	I 1	R	13.0773	28.1760	+ 84	+ 2.9	+ 2.7	40 42 44.32	— 6 21.94	9	— 81	—13	8	23.23	34.3
	2		18.3190	22.7087	+ 19	+ 1.4	+ 1.0	40 34 31.87	+ 1 51.03	3	+ 35	+ 4	9	23.35	
	3		13.6187	27.5907	+ 71	+ .8	.0	40 42 16.22	— 5 53.43	8	— 13	— 10	6	22.96	
	4		21.5343	18.3627	— 3	—1.4	—2.1	40 37 44.18	— 1 20.18	2	— 49	— 3	7	23.57	
	5		25.0777	16.4047	+ 55	-3.2	—1.1	40 32 44.09	+ 3 39.41	5	— 65	+ 7	7	22.94	33.9
	6		15.3047	22.4057	— 71	+ 1.7	+ 2.4	40 33 23.48	+ 2 59.35	4	— 57	+ 5	6	23.47	33.5
	7		27.8480	12.0893	— 4	— .1	— .4	40 43 2.12	— 6 38.41	9	— 6	—12	7	23.69	
	8		23.3020	16.5067	— 7	— .1	.0	40 33 31.03	+ 2 51.78	— 4	— 1	+ 5	6	22.87	33.4

1894.	Star.	P	Micrometer.		O	Levels. A	Levels. B	½(δ+δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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Nov 10	I 9	R	22.3240	17.4157	— 6	.0	+ .2	40 38 27.06	— 2 4.08	+ 3	+ 2	— 4	7	40 36 23.06	
Nov 11	10		9.2200 ii	31.0860 iv	+ 1	— .2	—1.2	40 27 9.00	+ 9 12.83	+1.27	— 18	+20	9	23.21	33.5
	IV 1	D	21.2637	19.1007	+ 7	+ .1	— .1	40 37 17.77	— 54.70	+ 1	0	— 2	13	23.19	35.8
	2		15.9110	17.5543	— 43	—2.7	—2.4	40 37 4.98	— 41.44	+ 1	— 73	— 1	11	22.92	
	3		11.6877	27.4987	— 56	+ .5	— .8	40 29 43.60	+ 6 39.60	— 9	— 2	+12	7	23.28	35.1
	4		22.7637	16.9783	— 5	—1.2	— .8	40 38 49.36	— 2 26.26	+ 3	— 29	— 5	10	22.89	
	5		12.5017 ii	28.7147 iv	— 20	— .7	—1.3	40 29 32.10	+ 6 49.85	+1.23	— 28	+12	6	23.08	35.0
	6		29.7333 iv	11.1130 ii	— 4	—2.2	— .8	40 28 31.36	+ 7 50.75	+1.21	— 45	+13	5	23.05	
	7		13.6917 ii	27.9223 iv	— 42	—1.1	—1.4	40 30 22.21	+ 5 59.68	+1.24	— 35	+10	6	22.94	
	8		29.9003	13.1797	+ 224	— .6	—1.5	40 43 27.10	— 7 3.30	+ 10	— 28	—13	7	23.56	34.7
	9		17.5693	21.5833	— 16	—1.8	—1.5	40 38 4.86	— 1 41.44	+ 2	— 48	— 4	11	23.03	
	10		15.4727	25.3803	+ 37	—1.1	—1.1	40 40 33.90	— 4 10.58	+ 6	— 3	— 7	6	23.34	34.9
	11		6.9240 ii	33.8763 iv	+ 24	+ .2	—1.4	40 25 0.68	+11 21.48	+1.17	— 14	+20	6	23.45	
	12		25.7833	13.0737	— 61	— .7	—1.3	40 41 44.19	— 5 21.17	+ 7	— 28	—10	7	22.78	34.3
	I 1	D	27.0730	12.0007	— 61	+ .5	+ .2	40 42 44.35	— 6 20.91	+ 9	+ 10	—13	8	23.58	30.6
	2		20.9597	16.5427	— 50	—2.2	— .5	40 34 31.89	+ 1 51.55	— 3	— 42	+ 4	9	23.12	
	3		28.4080	14.4707	+176	+ .6	— .3	40 42 16.24	— 5 52.81	+ 8	+ 5	—10	6	23.52	
	4		18.2120	21.4083	— 6	— .3	— .1	40 37 41.22	— 1 20.79	+ 2	— 6	— 3	7	23.55	
	5		15.2613	23.9523	— 29	+1.5	— .1	40 32 44.09	+ 3 39.66	— 5	+ 22	+ 7	7	24.06	30.6
	6		23.6273	16.5150	+ 3	+ .9	+1.4	40 33 23.48	+ 2 59.82	— 4	+ 3	+ 5	6	23.40	
	7		27.0883	11.3237	—109	— .6	—2.2	40 43 2.11	— 6 38.29	+ 9	— 37	—12	7	23.49	
	8		16.8030	23.6363	+ 15	— .6	— .8	40 33 30.99	+ 2 52.80	— 4	— 20	+ 5	6	23.66	30.0
	9		18.7017	23.5843	+ 50	—1.8	— .9	40 38 27.01	— 2 3.57	+ 3	— 40	— 4	7	23.10	30.4
Nov 12	10		31.4850 iv	9.6107 ii	+ 7	—1.7	—1.4	40 27 8.95	+ 9 13.05	+1.20	— 45	+20	9	23.04	30.4
	IV 1	R	20.0510	22.2133	+ 21	— .2	— .2	40 37 17.81	— 54.72	+ 1	— 5	— 2	13	23.16	31.3
	2		21.1980	19.5147	+ 3	+1.3	+1.8	40 37 5.02	— 42.57	+ 1	+ 43	— 1	11	22.99	
	3		27.2703	11.4680	— 88	—1.3	+ .4	40 29 43.65	+ 6 39.30	— 9	— 16	+12	7	22.89	31.6
	4		18.0183	23.8267	+ 47	—1.1	+1.4	40 38 49.42	— 2 26.97	+ 3	0	— 5	10	22.53	31.1
	5		28.5250 iv	12.3287 ii	— 13	+1.1	.0	40 29 32.17	+ 6 49.45	+1.23	+ 18	+12	6	23.21	
	6		10.4337 ii	29.0503 iv	+ 2	+2.1	+1.1	40 28 31.44	+ 7 50.67	+1.21	+ 48	+13	5	23.98	30.3
	7		26.3967 iv	12.2057 ii	+ 37	+ .5	+ .7	40 30 22.30	+ 5 58.87	+1.24	+ 17	+10	6	22.74	
	8		12.6530	29.4057	+149	+ .2	+1.2	40 43 27.19	— 7 3.92	+ 10	+ 18	—13	7	23.49	
	9		20.8023	16.7767	— 44	+2.0	+ .1	40 38 4.96	— 1 41.67	+ 2	+ 34	— 4	11	23.72	
	10		24.8117	14.9127	— 12	.0	— .2	40 40 34.02	— 4 10.24	+ 6	— 2	— 7	6	23.81	30.8
	11		33.3970 iv	6.4717 ii	— 3	—1.0	— .1	40 25 0.81	+11 20.73	+1.17	— 17	+20	6	22.80	30.7
Nov 15	12		14.5000	27.2057	+ 93	+ .3	+ .1	40 41 44.42	— 5 21.46	+ 7	+ 6	—10	7	23.06	
	IV 1	D	20.8310	18.6543	— 6	+ .3	+ .3	40 37 17.93	— 55.02	+ 1	+ 9	— 2	13	23.12	43.7
	2		20.7923	21.4750	+ 6	+1.7	+1.7	40 37 5.16	— 42.56	+ 1	+ 49	— 1	11	23.20	
	3		11.2847	27.0710	—114	+ 2.7	+ 1.6	40 29 43.83	+ 6 38.83	— 5	+ 63	+ 12	7	23.13	43.6
	4		22.3940	16.5687	— 26	+ .3	— .1	40 38 49.64	— 2 27.21	+ 2	+ 3	— 5	10	22.53	42.9
	5		11.8947 ii	28.0787 iv	0	+ .1	—1.0	40 39 22.41	+ 6 49.17	+1.27	— 11	+12	6	22.92	
	6		29.5933 iv	11.0147 ii	— 2	— .5	+ .3	40 28 31.72	+ 7 49.71	+1.26	— 4	+13	5	22.83	
	7		13.6603 ii	27.8397 iv	— 40	+2.0	+1.6	40 30 22.60	+ 5 58.39	+1.27	+ 52	+10	6	22.91	
	8		28.4897	11.6977	+ 13	+1.5	+ .8	40 43 27.53	— 7 4.56	+ 5	+ 34	—13	7	23.30	
	9		17.2520	21.3123	— 28	+ .5	+ .5	40 38 5.32	— 1 42.58	+ 1	+ 14	— 4	11	22.96	44.0
	10		15.4167	25.3693	+ 35	+ .4	+1.1	40 40 34.43	— 4 11.71	+ 3	+ 20	— 7	6	22.94	
	11		6.8280 ii	33.7553 iv	+ 16	— .6	— .2	40 25 1.22	+11 20.82	+1.23	+ 7	+20	6	23.60	43.6
	12		26.6400	13.8987	+ 28	+ .5	+ .5	40 41 44.76	— 5 22.20	+ 4	+ 14	—10	7	22.71	
	I 1	R	13.1490	28.2387	+ 93	+2.0	+1.7	40 42 44.58	— 6 21.74	+ 5	+ 54	—13	8	23.38	42.9
	2		18.7520	23.1777	+ 37	— .2	— .1	40 34 32.06	+ 1 51.99	— 1	— 3	+ 4	9	24.14	42.8
	3		12.2103	26.1987	— 98	— .3	+1.9	40 42 16.41	— 5 53.41	+ 4	+ 19	—10	6	23.19	
	4		21.7830	18.5880	+ 5	+ .7	— .5	40 37 44.34	— 1 20.79	+ 1	+ 5	— 3	7	23 65	41.8
	5		24.8183	16.1600	+ 35	— .4	+1.2	40 32 44.13	+ 3 38.99	— 3	+ 8	+ 7	7	23.31	
	6		16.5420	23.6563	+ 7	+ .3	— .1	40 33 23.51	+ 2 59.88	— 2	+ 3	+ 5	6	23.51	
	8		23.4813	16.6500	+ 5	— .2	+ .2	40 33 30.82	+ 2 52.72	— 2	0	+ 5	6	23.63	40.4

1874	Star.	P	Micrometer.	C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Ther. mom.
							° ′ ″						° ′ ″	°
Nov														
15	I 9	R	21.3740	16.4719	47	.0	+ .7	10 38 26.86	− 2 3.81	+ 2	+ 9	4 7	40 36 23.16	
Nov	10		9.0590	30.9247	0	+ 1 1	+ 1.2	40 27 8.71	− 9 13.04	+ 1.25	33	20 9	23.65	40.3
16	IV 1	R	20.4010	22.5993	+ 28	+ 1 8	+ 1 8	40 37 17.95	− 55.65	− 1	+ 51	2 13	22.93	51.1
	3		27.8213	12.0350	− 10	+ 2 2	+ 1.7	40 29 43.87	+ 6 38.58	− 5	+ 57	+ 12 7	23.16	50.4
	4		17.0410	22.8723	− 1	.5	+ 2.1	40 38 49.70	− 2 27.43	+ 2	+ 34	5 10	22.68	
	5		27.9033	11.7517	6	+ 1 2	+ .8	10 29 32.48	+ 6 48.36	+ 1.27	29	+ 12 6	22.58	
	6		10.4210	29.0293[iv]	+ 2	+ 2.0	+ .6	40 28 31.80	+ 7 50.47	+ 1.26	40	13 5	24.11	50.2
	7		27.1247[iv]	12.9317[i]	6	+ 1 9	− .2	40 30 22.69	+ 5 58.83	+ 1.27	33	+ 10 6	22.62	48.6
	8		12 0597	28.8270	62	+ 1.9	.5	10 43 27.61	− 7 4.30	− 5	37	13 7	22.96	
	9		21.9483	17.9987	3	+ .1	.5	40 38 5.43	+ 1 42.12	+ 1	3	− 4 11	23.36	
	10		24.6363	14.6963	30	+ 1.0	.0	40 40 34.56	− 4 11.23	+ 3	+ 16	7 6	23.51	48.1
	11		33.9737[i]	7 0647	31	+ .1	.0	10 25 1 36	+ 11 20.10	+ 1.23	+ 1	20 6	23.26	17.9
	12		14.2290	26 9187	55	+ 1.3	+ 1.6	40 41 44.90	− 5 20.96	+ 4	11	10 7	23.54	
	I 1	D	27.1607	12.3677	10	+ 2 1	+ 1.9	10 42 11.68	− 6 21.56	+ 5	+ 63	13 8	22.49	42.4
	2		20.2030	15.8010	77	+ .8	+ 1.3	40 34 32.15	+ 1 51 02	− 1	− 3	+ 4 9	23.26	
	3		28.7193	11.8223	+ 217	+ .2	− .5	10 42 16.50	− 5 52.66	+ 4	+ 3	− 10 6	23.81	
	4		17.6100	20 8277	23	− 6	.7	40 37 41 41	− 1 21.39	+ 1	+ 18	3 7	22.99	41.8
	5		15.3030	23.9753	27	2	.5	40 32 41.21	+ 3 39.19	− 3	− 9	+ 7 7	23.60	
	6		22.9240	15.8050	41	1.7	1.5	40 33 23.56	− 2 59 88	− 2	+ 46	+ 5 6	23.07	
	7	R	11.4513	27.1937	91	+ 2 0	1.5	40 43 2.12	− 6 37.77	+ 5	+ 52	−12 7	23.83	41.4
	8		16.0870	22.9133	30	+ 1.1	+ 1.2	40 33 30.89	+ 2 52.51	− 2	+ 33	+ 5 6	23.82	41.4
Nov	10		30 8757[iv]	8.9823[i]	0	+ 1 3	.4	40 27 8.73	− 9 13.52	+ 1.25	26	+20 9	23.53	41.1
19	IV 1	D	21.0467	18 8643	1	0	+ .2	40 37 17.91	− 55.17	− 1	+ 2	− 2 13	22.88	33.4
	2		17.2200	18.9160	30	+ .7	+ 5	10 37 5 17	− 42.80	+ 1	+ 18	− 1 11	22.66	
	3		12 3730	28.1717	37	− 1	+ 1.0	40 29 43.88	+ 6 39.60	− 5	− 14	12 7	23.48	32.8
	4		22.2847	16.4617	31	− 2	.0	40 38 49.76	− 2 27.13	+ 2	− 3	− 5 10	22.73	
	5		12.6187[i]	28 7783[i]	− 21	0	.8	40 29 32.56	+ 6 48.49	+ 1.27	− 10	+12 6	22.60	
	6		29.7780[i]	11 2200[ii]	− 4	+ .3	+ 2.2	40 28 31.91	+ 7 49.18	+ 1.26	+ 32	+ 13 5	22.88	31.4
	7		12.2940[i]	26.4623[i]	32	+ 1.6	+ 1.4	40 30 22.86	+ 5 58.29	+ 1.27	− 43	+ 10 6	23.01	
	8		29 7443	12 9443	+198	+ .5	+ .4	40 43 27.93	− 7 5.24	+ 5	+ 13	13 7	22.81	30 5
	9		17.2573	21.3530	− 27	+3.0	+2.1	40 38 5.68	− 1 43.48	+ 1	+ 75	− 4 11	23.03	
	10		15 4523	25.4437	+ 34	.0	− .2	40 40 34.86	− 4 12.70	+ 3	− 2	− 7 6	22.16	30.4
	11		6.7717[i]	33.6613[iv]	+ 13	+ .3	.0	40 25 1.68	+ 11 19.71	+1.23	+ 5	+20 6	22.93	30.5
	12		25.5090	12.7457	− 97	.0	.3	40 41 45.26	− 5 22 44	+ 4	− 4	−10 7	22.79	30.5
	I 1	R	12.9630	28.0240	62	+ 1.0	+ 1.5	10 42 15.01	− 6 20.93	+ 5	− 72	13 8	23.39	21.6
	2		18.3697	22.7830	+ 22	+ 3.3	−5.0	40 31 32.47	+ 1 51.63	− 1	+ 1.16	+ 4 9	23.06	
	3		12.8100	26 7757	− 27	+ 1 9	+ 1.5	10 42 16.83	− 5 53.02	+ 1	− 49	−10 6	23.32	
	4		22.5567	19.3610	− 27	+ .7	−2.0	40 37 41.70	− 1 20.86	+ 1	− 36	+ 3 7	23.53	23.5
	5		24 5150	15.8553	+ 11	+ 1 5	+ 1	10 32 41.46	+ 3 38.97	− 3	− 22	+ 7 7	23.32	
	6		16.3307	23.4477	9	+ .5	+ 1.3	40 33 23.79	− 2 59.92	− 2	− 8	+ 5 6	23.72	
	7		12.5173	28.2753	+ 54	+ 1.9	.0	10 43 2.31	− 6 38.53	+ 5	− 31	− 12 7	23.47	22 9
	8		17.3997	24.2383	+ 50	+ 1.2	− .1	40 33 31.01	+ 2 53.02	− 2	− 21	+ 5 6	23.91	22.7
	9		18 3443	23 2617	+ 31	+ 1.0	+ 1.8	40 38 26.95	− 2 4.11	+ 2	+ 38	+ 4 7	22.97	
Nov	10		31.1050[i]	9.2247[i]	+ 1	+ 1.8	+ .4	40 27 8.58	+ 9 13.19	+ 1.25	+ 31	+20 9	22.97	23.4
20	IV 1	R	20.5257	22.7080	+ 30	+3.2	+ 1.8	40 37 17.85	− 55.25	+ 1	+ 74	+ 2 13	23.46	30.3
	2		21.3423	19.6723	+ 5	+ .7	+ .5	10 37 5.12	− 42.23	+ 1	+ 18	− 1 11	23.18	
	3		27 7907	12.0060	− 13	+ .9	+ .1	10 29 43 85	+ 6 39.01	− 5	− 13	+ 12 7	22.90	30.5
	4		17.4393	23 2670	+ 16	+ 1.4	− .3	10 38 19.75	− 2 27.38	+ 2	— 26	− 5 10	22.18	30.0
	5		28 5177[i]	12.3107[i]	− 13	+ 1.8	+ 1.0	10 29 32 55	+ 6 49.72	+ 1.27	— 41	+ 12 6	23.31	
	6		11.3927[i]	29.9837[i]	− 8	+ .6	.0	40 28 31.95	+ 7 50.00	+ 1.26	+ 9	+ 13 5	23.48	29.2
	7		26.8103[iv]	12 6323[ii]	+ 16	+ .1	+ .4	40 30 22.88	− 5 58.49	+ 1.27	+ 3	+ 10 6	22.83	
	8		12.6350	29.4023	+ 146	+ .8	+ .1	10 43 27.87	− 7 4.26	+ 5	— 8	− 13 7	23.52	
	9		22.0370	17.9927	+ 1	−1.0	−1.6	40 38 5.72	− 1 42.25	+ 1	− 36	− 4 11	23.19	29.2
	10		24.9803	15.0413	−104	− .2	− .6	40 40 34.91	− 4 11.02	+ 3	− 10	− 7 6	23.81	
	11		34.7383[iv]	7.8453[ii]	+ 79	− .3	+ .2	40 25 1.75	+11 20.12	+ 1.23	— 2	+ 20 6	23.34	28.9

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Nov								° ′ ″						° ′ ″	
20	IV12	R	14.5637	27.2717	+100	—1.3	—2.2	40 41 45.34	— 5 21.54	+ 4	— 48	—10	7	40 36 23.33	
21	IV 1	D	20.6937	18.5387	— 7	+1.4	+1.0	40 37 17.79	— 54.47	+ 1	+ 35	— 2	13	23.79	39.8
	2		20.4387	22.1210	+ 17	— .1	+ .9	40 37 5.07	— 42.58	+ 1	+ 9	— 1	11	22.69	
	3		11.8557	27.6553	— 34	+1.1	.0	40 29 43.80	+ 6 39.36	— 5	+ 18	+12	7	23.48	39.8
	4		22.3893	16.5407	— 28	+1.9	+1.3	40 38 49.72	— 2 27.80	+ 2	+ 47	— 5	10	22.46	39.4
	5		12.8380 ii	29.0363 iv	— 32	—1.1	— .3	40 29 32.53	+ 6 49.45	+1.27	— 22	+12	6	23.21	
	6		30.0783 iv	11.5077 ii	— 8	— .2	+1.8	40 28 31.94	+ 7 49.49	+1.26	+ 19	+13	5	23.06	39.2
	7		12.9507 ii	27.1100 iv	— 1	+2.8	+2.0	40 30 22.88	+ 5 57.98	+1.27	+ 70	+10	6	22.99	
	8		28.4823	11.7103	+ 13	+ .1	— .4	40 43 27.89	— 7 4.07	+ 5	— 3	—13	7	23.78	38.9
	9		18.0480	22.1163	+ 2	+2.0	+ .7	40 38 5.75	— 1 42.86	+ 1	+ 41	— 4	11	23.38	38.6
	10		14.8923	24.8623	— 10	+ .1	+ .6	40 40 34.96	— 4 12.04	+ 3	+ 9	— 7	6	23.03	
	11		7.7377 ii	34.6267 iv	+ 71	+ .3	— .4	40 25 1.80	+11 20.00	+1.23	0	+20	6	23.29	38.4
Nov	12		26.9027	14.1630	+ 58	—1.2	— .5	40 41 45.40	— 5 22.24	+ 4	— 26	—10	7	22.91	
22	IV 1	R	18.5247	20.6963	— 7	+2.6	+ .8	40 37 17.73	— 54.89	+ 1	+ 52	— 2	13	23.48	41.5a
	2		21.0620	19.4100	+ 2	—1.1	—1.4	40 37 5.02	— 41.77	+ 1	— 35	— 1	11	23.01	41.6
	4		17.5913	23.4160	+ 26	+ .8	+1.1	40 38 49.69	— 2 27.33	+ 2	+ 27	— 5	10	22.70	
	5		28.0037 iv	11.8363 ii	+ 2	+ .4	+ .1	40 29 32.53	+ 6 48.75	+1.27	+ 8	+12	6	22.81	41.6
	6		10.7070 ii	29.2763 iv	+ 0	+1 5	+1.6	40 28 31.93	+ 7 49.47	+1.26	+ 44	+13	5	23.28	41.2
	7		26.8330 iv	12.6617 ii	+ 15	— .2	+1.0	40 30 22.88	+ 5 58.32	+1.27	+ 9	+10	6	22.72	
	8		12.7247	29.5143	+162	.0	+ .3	40 43 27.90	— 7 4.89	+ 5	+ 4	—13	7	23.04	41.1
	9		23.5563	19.5027	+ 55	— .9	—1.4	40 38 5.78	— 1 42.62	+ 1	— 32	— 4	11	22.92	
	10		25.2903	15.3170	+ 26	+2.1	+1.0	40 40 35.00	— 4 12.21	+ 3	+ 46	— 7	6	23.27	41.1
	11		33.7200 iv	6.8087 ii	+ 15	— .6	— .5	40 25 1.85	+11 20.42	+1.23	— 16	+20	6	23.60	41.2
Nov	12		14.3287	27.0830	+ 78	— .2	—1.3	40 41 45.45	— 5 22.66	+ 4	— 19	—10	7	22.61	
24	I 1	D	26.9583	11.8360	— 80	—1.4	—2.2	40 42 45.45	— 6 22.12	+ 5	— 50	—13	8	22.83	35.5
	2		22.2800	17.9163	+ 4	+1.1	+1.1	40 34 32.83	+ 1 50.33	— 1	+ 32	+ 4	9	23.60	
	3		27.6900	13.7113	+ 86	— .2	+ .1	40 42 17.21	— 5 53.63	+ 4	— 1	—10	6	23.57	
	4		18.3613	21.6080	— 2	—1.1	— .5	40 37 45.02	— 1 22.08	+ 1	— 24	— 3	7	22.75	35.5
	6		23.7293	16.6347	+ 12	—1.3	— .4	40 33 24.05	+ 2 59.40	— 2	— 26	+ 5	6	23.28	
	7		27.8870	12.0913	— 2	— .7	— .4	40 43 2.52	— 6 39.35	+ 5	— 16	—12	7	23.01	35.5d
Nov	8		23.1597	16.3450	— 17	+ .5	+1.9	40 33 31.13	+ 2 52.25	— 2	+ 32	+ 5	6	23.79	35.4
26	IV 1	D	20.8280	18.6757	— 5	+ .6	+ .3	40 37 17.59	— 54.40	+ 1	+ 13	— 2	13	23.44	32.0
	2		18.7050	20.3593	— 6	.0	— .2	40 37 4.91	— 41.81	+ 1	— 2	— 1	11	23.19	
	3		13.0083	28.8123	+125	+ .3	— .5	40 29 43.66	+ 6 39.88	— 5	— 1	+12	7	23.67	32.1
	4		23.3680	17.5610	+ 22	— .8	— .4	40 38 49.66	— 2 26.87	+ 2	— 18	— 5	10	22.68	32.0
	5		12.0317 ii	28.2287 iv	— 3	—1.2	—1.7	40 29 32.47	+ 6 49.49	+1.27	— 41	+12	6	23.00	
	6		30.3323 iv	11.7713 ii	— 13	+2.0	+1 5	40 28 31.95	+ 7 49.23	+1.26	+ 51	+13	5	23.13	31.9
	7		13.6867 ii	27.8743 iv	— 42	+ .9	+ .2	40 30 22.93	+ 5 58.59	+1.27	+ 12	+10	6	23.07	
	8		28.3207	11.5277	— 13	+ .4	— .8	40 43 28.00	— 7 4.53	+ 5	— 4	—13	7	23.42	
	9		18.9810	23.0493	+ 36	+ .2	.0	40 38 5.94	— 1 42.95	+ 1	+ 3	— 4	11	23.10	31.4
	10		15.1733	25.1353	+ 14	— .7	— .1	40 40 35.18	— 4 11.90	+ 3	— 13	— 7	6	23.17	
	11		7.2520 ii	34.1707 iv	+ 43	—1.8	—1.8	40 25 2.06	+11 20.68	+1.23	— 51	+20	6	23.72	31.8
Nov	12		26.9593	14.2100	+ 63	— .3	— .6	40 41 45.70	— 5 22.49	+ 4	— 12	—10	7	23.10	32.0
27	IV 1	R	20.6747	22.8660	+ 34	+1.4	+1.5	40 37 17.58	— 55.49	+ 1	+ 41	— 2	13	22.62	47.7
	2		21.6617	19.9877	+ 11	+ .4	+1.5	40 37 4.90	— 42.35	+ 1	+ 25	— 1	11	22.91	
	3		28.2627	12.4797	+ 48	— .1	+ .1	40 29 43.66	+ 6 39.15	— 5	— 0	+12	7	22.95	47.2a
	4		16.4277	22.2807	— 34	+1.1	+ .5	40 38 49.67	— 2 27.89	+ 2	+ 24	— 5	10	22.09	
	5		28.7120 iv	12.5610 ii	— 22	+ .8	+ .7	40 29 32.48	+ 6 48.27	+1.27	+ 22	+12	6	22.42	48.0
	6		11.0093 ii	29.5523 iv	— 2	+2.5	+1.1	40 28 31.98	+ 7 48.80	+1.26	+ 54	+13	5	22.76	47.6
	7		27.7573 iv	13.5943 ii	— 36	— .9	+ .3	40 30 22.96	+ 5 57.98	+1.27	— 10	+10	6	22.27	
	8		12.4017	29.2143	+116	+ .4	+ .3	40 43 28.04	— 7 5.35	+ 5	+ 10	—13	7	22.78	47.2
	9		22.4877	18.4293	+ 16	+1.6	+1.5	40 38 6.00	— 1 42.65	+ 1	+ 45	— 4	11	23.88	*
	10		25.2593	15.2620	+ 22	+1.3	+ .5	40 40 35.25	— 4 12.81	+ 3	+ 27	— 7	6	22.73	46.0
	11		33.3337 iv	6.4587 ii	— 8	+1.2	+1.2	40 25 2.14	+11 19.44	+1.23	+ 34	+20	6	23.41	
	12		14.3010	27.0530	+ 74	— .5	— .3	40 41 45.78	— 5 22.59	+ 4	— 12	—10	7	23.08	46.0

* Hurried.

1897.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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Nov 27	I 1	R	13.1997	28.3063	+100	+ .4	.0	40 42 45.60	— 6 22.18	+ 5	+ 6	—13	8	40 36 23.48	41.4
	2		17.2260	21.5887	— 25	— .5	+ .1	40 34 32.95	+ 1 50.24	— 1	— 6	+ 4	9	23.25	41.3
Nov 28	3		13.0837	27.0707	+ 9	- .5	—1.1	40 42 17.35	— 5 53.65	+ 4	— 22	—10	6	23.48	40.8
	IV 1	D	21.6647	19.4820	+ 10	+1.0	+ .6	40 37 17.57	— 55.21	+ 1	+ 23	— 2	13	22.71	31.0
	2		19.6687	21.3497	. 6	.0	.0	40 37 4.89	— 42.51	+ 1	— 0	— 1	11	22.49	
	3		12.6363	28.4220	+ 73	+ .2	— .1	40 29 43.65	+ 6 39.28	— 5	+ 1	+12	7	23.08	30.6
	4		21.6667	15.8277	— 64	+ .3	+ .5	40 38 49.68	— 2 27.46	+ 2	+ 11	— 5	10	22.40	
	5		11.0777 II	27.3047 IV	+ 28	- 3.5	+2.7	40 29 32.49	+ 6 50.33	+1.27	+ 90	+12	6	[25.17]	
	6		29.7147 IV	11.1400 II	— 3	.0	+1.1	40 28 32.01	+ 7 49.60	+1.26	+ 14	+13	5	23.19	30.0
	7		12.8593 II	27.0350 IV	+ 1	+ 2.0	+ .8	40 30 23.00	+ 5 58.37	+1.27	+ 42	+10	6	23.22	
	8		28.3753	11.5720	— 1	.1	— .5	40 43 28.09	— 7 4.82	+ 5	— 8	—13	7	23.18	29.4
	9		19.7630	23.8430	+ 65	- 1.1	+ .1	40 38 6.06	— 1 43.36	+ 1	— 16	— 4	11	22.62	29.3
	10		11.8387	24.8373	— 13	— .2	+ .7	40 40 35.33	— 4 12.75	+ 3	+ 6	— 7	6	22.66	29.0
	11		7.3597 II	34.2490 IV	— 49	+1.2	— .8	40 25 2.22	+11 19.95	+1.23	+ 9	+20	6	23.75	
	12		26.5347	13.7597	+ 17	+2.6	+1.9	40 41 45.87	— 5 23.02	+ 4	+ 66	—10	7	23.52	29.0
Nov 29	IV 1	R	20.7197	22.8857	+ 34	.0	— .7	40 37 17.54	— 54.85	+ 1	— 9	— 2	13	22.72	28.6
	2		21.5377	19.8917	+ 9	+1.0	— .1	40 37 4.87	— 41.64	+ 1	+ 14	— 1	11	23.48	
	3		28.4770	12.6757	+ 71	- .5	+ .4	40 29 43.60	+ 6 39.67	— 5	— 3	+12	7	23.38	27.8
	4		17.2020	23.9917	+ 35	2.1	—1.4	40 38 49.68	— 2 26.47	+ 2	— 51	— 5	10	22.77	
	5		28.5883 IV	12.4117 II	— 17	+ .4	+ .9	40 29 32.50	+ 6 48.94	+1.27	+ 17	+12	6	23.06	
	6		11.0840 II	29.6807 IV	— 3	1.2	—1.6	40 28 32.02	+ 7 50.16	+1.26	— 39	+13	5	23.23	27.4
	7		26.5580 IV	12.3760 II	+ 28	+ .7	.5	40 30 23.03	+ 5 58.62	+1.27	+ 18	+ 10	6	23.26	
	8		12.4497	29.2210	+ 120	—1.5	.0	40 43 28.13	— 7 4.32	+ 5	— 24	—13	7	23.56	
	9		22.9857	18.9147	+ 34	1.6	+ .7	40 38 6.13	— 1 43.01	+ 1	+ 35	— 4	11	23.55	27.3
	10		24.9340	14.9663	— 3	1.6	.0	40 40 35.39	— 4 12.01	+ 3	+ 26	— 7	6	23.66	
	11		33.3627 IV	6.4703 II	— 4	1.7	— .4	40 25 2.30	+ 11 19.89	+1.23	— 32	+ 20	6	23.36	26.8
Dec. 3	12		14.2643	27.0357	+ 70	.1	+ .3	40 41 45.96	— 5 23.07	+ 4	+ 3	—10	7	22.93	
	IV 3	D	12.4063	28.2207	+ 43	+ .3	+ .5	40 29 43.38	+ 6 39.93	— 5	+ 11	+12	7	23.56	35.4
	4		22.4830	16.6803	— 21	—1.3	— .6	40 38 49.53	— 2 26.65	+ 2	— 28	— 5	10	22.67	
	5		11.9337 II	28.1047 IV	0	+1.1	+1.4	40 29 32.34	+ 6 48.84	+1.27	+ 35	+12	6	22.98	35.4
	6		29.9897 IV	11.4100 II	— 8	+ .2	+1.8	40 28 31.93	+ 7 49.72	+1.26	+ 25	+13	5	23.34	34.8
	7		12.5637 II	26.7437 IV	+ 18	+ .6	— .2	40 30 22.97	+ 5 58.55	+1.27	+ 6	+10	6	23.01	
	8		29.6850	12.8897	+190	+ 3.0	+ .5	40 43 28.14	— 7 5.10	+ 5	+ 55	—13	7	23.58	
	9		17.6487	21.7300	— 12	+ .3	+1.0	40 38 6.23	— 1 43.15	+ 1	+ 18	— 4	11	23.34	34.6
	10		15.4880	25.4813	+ 43	+1.3	+1.9	40 40 35.52	— 4 12.76	+ 3	+ 45	— 7	6	23.23	35.4
	11		6.9557 II	33.8453 IV	+ 26	- .3	—1.0	40 25 2.47	+11 19.90	+1.23	— 17	+ 20	6	23.69	35.2
	12		26.7077	13.8920	+ 34	+2.6	+2.1	40 41 46.18	— 5 24.10	+ 4	+ 68	—10	7	22.77	
	I 1	D	26.5607	11.4043	—136	+ .4	+ .2	40 42 46.30	— 6 22.85	+ 5	+ 9	—13	8	23.54	30.0
	2		21.7547	17.4307	— 16	1.9	—1.1	40 34 33.58	+ 1 49.28	— 1	— 44	+ 4	9	22.54	
	3		26.6410	12.6173	— 46	+ .6	— .4	40 42 18.00	— 5 54.44	+ 4	+ 4	—10	6	23.60	30.5
	4		17.8490	21.1270	— 16	+ .8	+1.8	40 37 45.69	— 1 22.83	+ 1	+ 35	— 3	7	23.26	30.5
	5		16.4910	25.1323	— 61	.7	— .6	40 32 45.37	+ 3 38.63	— 3	— 19	+ 7	7	23.92	30.3
	6		23.6993	16.6310	+ 10	1.4	— .3	40 33 24.59	+ 2 58.73	— 2	— 26	+ 5	6	23.15	
	7		27.4757	11.6927	— 59	- .2	— .9	40 43 2.96	— 6 38.88	+ 5	— 14	—12	7	23.94	
	8		23.3970	16.5873	0	—1.5	— .7	40 33 31.40	+ 2 52.16	— 2	— 33	+ 5	6	23.32	29.9
	9		21.6123	16.6993	— 39	.8	—1.0	40 38 27.21	— 2 4.11	+ 2	— 25	— 4	7	22.90	
Dec. 4	10		8.6503 II	30.5260 IV	— 6	.1	— .6	40 27 8.85	+ 9 13.05	+1.25	— 9	+20	9	23.35	30.0
	IV 2	D	18.3543	20.0010	— 12	—1.4	— .6	40 37 4.48	— 41.60	+ 1	— 30	— 1	11	22.69	36.4
	3	R	29.8337	14.0693	+270	+ 2.0	+2.0	40 29 43.28	+ 6 39.24	— 5	+ 57	+12	7	23.23	35.9
	4		18.8190	24.6157	+ 87	2.8	—1.2	40 38 49.44	— 2 26.77	+ 2	— 60	— 5	10	22.14	35.4
	5		27.1510 IV	10.9887 II	+ 32	+1.1	+ .7	40 29 32.26	+ 6 48.70	+1.26	+ 27	+12	6	22.67	
	6		10.8067 II	29.3860 IV	0	+ .8	— .2	40 28 31.86	+ 7 49.73	+1.25	+ 8	+13	5	23.10	35.0
	7		26.8930 IV	12.6967 II	+ 11	—1.3	.0	40 30 22.91	+ 5 58.94	+1.26	— 21	+10	6	23.06	34.7
	8		11.1157	27.9217	73	— .3	.0	40 43 28.10	— 7 4.71	+ 5	— 5	—13	7	23.33	34.4
	9		20.9740	16.9043	— 39	— .3	— .3	40 38 6.21	— 1 42.79	+ 1	— 9	— 4	11	23.41	

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Dec.								° ′ ″						° ′ ″	°
4	IV 10	R	24.2917	14.3150	— 60	+ .8	+ .7	40 40 35.51	— 4 12.08	+ 3	+ 22	— 7	6	40 36 23.67	33.9
	11		32.8613iv	5.9793ii	— 34	—1.1	—1.2	40 25 2.47	+11 19.55	+1.23	— 33	+20	6	23.18	33.8
	12		13.3743	26.1567	— 27	—1.2	—1.2	40 41 46.19	— 5 23.10	+ 4	— 34	—10	7	22.76	
	I 1	R	19.6447iv	34.8273ii	—366	+ .9	— .5	40 42 46.41	— 6 22.93	+ 5	+ 8	—13	8	23.56	27.8
	2		18.3407	22.6983	+ 19	—2.8	—2.8	40 34 33.69	+ 1 50.22	— 1	— 80	+ 4	9	23.23	
	3		12.5507	26.5827	— 53	—2.4	—2.1	40 42 18.12	— 5 54.63	+ 4	— 65	—10	6	22.84	
	4		21.8250	18.5843	+ 5	+ .2	— .8	40 37 45.80	— 1 21.94	+ 1	— 7	— 3	7	23.84	28.7
	5		24.6377	16.0233	+ 25	—1.2	+ .1	40 32 45.43	+ 3 37.86	— 3	— 13	+ 7	7	23.27	
	6		16.2747	23.3473	— 11	— .2	.0	40 33 24.69	+ 2 58.78	— 2	— 3	+ 5	6	23.53	
	7		12.9923	28.7483	+121	—3.2	—1.2	40 43 2.95	— 6 38.65	+ 5	— 66	—12	7	23.64	27.7
	8		16.5373	23.3507	— 5	.0	+ .2	40 33 31.48	+ 2 52.25	— 2	+ 2	+ 5	6	23.84	
	9		17.9533	22.8873	+ 19	+ .3	+ .4	40 38 27.28	— 2 4.79	+ 2	+ 10	— 4	7	22.64	28.0
Dec.	10		31.8800iv	9.9940ii	+ 16	—1.2	— .3	40 27 8.90	+ 9 13.37	+1.24	— 23	+20	9	23.57	
5	IV 2	D	18.1143	19.7503	— 15	+1.4	+ .4	40 37 4.37	— 41.32	+ 1	+ 27	— 1	11	23.43	32.4
	3		11.2603	27.1013	—111	+ .5	— .5	40 29 43.16	+ 6 40.22	— 5	+ 1	+12	7	23.53	
	4		20.7427	14.9380	—108	— .9	— .8	40 38 49.35	— 2 26.48	+ 2	— 24	— 5	10	22.70	31.8
	5		11.7123ii	27.9053iv	+ 7	+ .1	+ .3	40 29 32.16	+ 6 49.41	+1.26	+ 5	+12	6	23.06	
	6		29.7927iv	11.2127ii	— 4	+ .9	+1.6	40 28 31.78	+ 7 49.74	+1.25	+ 34	+13	5	23.29	
	7		12.7483ii	26.9417iv	+ 8	+ .9	.0	40 30 22.84	+ 5 58.86	+1.26	+ 15	+10	6	23.27	
	8		28.8440	12.0473	+ 62	+1.5	+ .8	40 43 28.04	— 7 4.82	+ 5	+ 84	—13	7	23.55	33.0
	9		17.8370	21.9350	— 1	— .6	—1.0	40 38 6.17	— 1 43.60	+ 1	— 22	— 4	11	22.43	
	10		14.2147	24.2123	— 69	.0	+ .1	40 40 35.48	— 4 12.59	+ 3	+ 1	— 7	6	22.92	33.0
	11		6.1267	33.0233	— 28	+ .3	—1.0	40 25 2.45	+11 19.94	+1.22	— 7	+20	6	23.80	
	12		27.9490	14.2660	+ 74	+ .1	— .8	40 41 46.18	— 5 23.37	+ 4	— 8	—10	7	22.74	33.0
	I 1	D	26.1890	11.0167	—188	—1.5	—1.1	40 42 46.52	— 6 23.12	+ 5	— 38	—13	8	23.02	28.8
	2		20.8883	16.5693	— 49	— .7	.0	40 34 33.79	+ 1 49.06	— 1	— 11	+ 4	9	22.86	
	3		27.8253	13.7760	+100	+2.6	+ .8	40 42 18.22	— 5 55.45	+ 4	+ 52	—10	6	23.29	
	4		17.8697	21.1373	— 16	—1.9	—1.5	40 37 45.88	— 1 22.57	+ 1	— 49	— 3	7	22.87	29.0
	5		14.7557	23.3657	— 70	+1.7	+1.0	40 32 45.52	+ 3 37.50	— 3	+ 40	+ 7	7	23.53	
	6		23.8113	16.7520	+ 18	— .7	+ .7	40 33 24.78	+ 2 58.52	— 2	— 2	+ 5	6	23.37	
	7		28.0870	12.2920	+ 17	— .4	+ .4	40 43 3.13	— 6 39.38	+ 5	— 1	—12	7	23.74	
	8		24.0273	17.2507	+ 38	— .5	+ .2	40 33 31.55	+ 2 51.42	— 2	— 5	+ 5	6	23.01	29.8
	9		23.3690	18.4447	+ 40	+1.2	+ .1	40 38 27.34	— 2 4.60	+ 2	+ 21	— 4	7	23.00	
Dec.	10		8.7007ii	30.5733iv	— 6	.0	— .4	40 27 8.95	+ 9 12.97	+1.24	— 5	+20	9	23.40	29.8
6	IV 2	R	21.1620	19.5133	+ 2	+ .6	— .2	40 37 4.26	— 41.69	+ 1	+ 7	— 1	11	22.75	41.0
	3		26.9157	11.1173	—138	+1.4	+1.8	40 29 43.05	+ 6 39.07	— 5	+ 45	+12	7	22.71	*a*
	4		16.9040	22.7240	— 11	— .3	+ .8	40 38 49.26	— 2 27.12	+ 2	+ 5	— 5	10	22.26	39.8
	5		28.1230iv	11.9470ii	— 1	+ .9	+ .8	40 29 32.06	+ 6 48.96	+1.26	+ 24	+12	6	22.70	39.4
	6		10.5157ii	29.0940iv	+ 2	+2.3	+1.2	40 28 31.70	+ 7 49.71	+1.25	+ 52	+13	5	23.36	
	7		26.6153iv	12.4407ii	+ 25	— 6	— .6	40 30 22.77	+ 5 58.43	+1.26	— 17	+10	6	22.45	
	8		12.2377	29.0380	+ 90	— .2	+ .1	40 43 27.98	— 7 4.98	+ 5	— 1	—13	7	22.98	39.4
	9		22.8540	18.7560	+ 29	+1.9	+ .9	40 38 6.14	— 1 43.68	+ 1	+ 41	— 4	11	22.95	
	10		24.6630	14.6983	— 28	— .5	—1.7	40 40 35.45	— 4 11.86	+ 3	— 29	— 7	6	23.32	38.5
	11		32 7040iv	5.8193ii	46	.0	+ .7	40 25 2.43	+11 19.59	1.22	9	20	6	23.59	38.0
	12		13.0690	25.8323	— 61	—3.5	—2.7	40 41 46.18	— 5 22.53	+ 4	— 90	—10	7	22.76	
	I 2	R	19.5957	23.9017	+ 65	+ .7	+1.0	40 34 33.87	+ 1 49.03	— 1	+ 24	+ 4	9	23.26	32.0
	3		12.4370	26.4870	— 63	— .8	— .4	40 42 18.31	— 5 55.06	+ 4	— 18	—10	6	23.07	
	4		22.2833	19.0350	— 19	+1.1	.0	40 37 45.98	— 1 22.17	+ 1	+ 18	— 3	7	24.04	32.8
	5		24.8327	16.2260	+ 38	— .4	+1.3	40 32 45.59	+ 3 37.69	— 3	+ 10	+ 7	7	23.49	
	6		15.4497	22.4907	— 64	+2.3	+2.6	40 33 24.84	+ 2 57.85	— 2	+ 70	+ 5	6	23.48	32.6
	7		11.3197	27.1473	—108	— .8	+ .9	40 43 3.19	— 6 39.89	+ 5	— 2	—12	7	23.28	32.6
	8		16.3680	23.1507	— 12	+1.8	+1.3	40 33 31.59	+ 2 51.45	— 2	+ 45	+ 5	6	23.58	32.3
	9		17.7680	22.6917	+ 10	+ .1	— .3	40 38 27.38	— 2 4.51	+ 2	— 2	— 4	7	22.90	
Dec.	10		29.8953iv	8.0533ii	— 16	+2.8	+1.9	40 27 9.00	+ 9 12.18	+1.24	+ 69	+20	9	23.40	32.4
23	I 1	D	28.7647	13.5567	+152	.0	.0	40 42 48.20	— 6 24.95	+ 7	0	—13	8	23.27	24.6

1894.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Dec.								° ′ ″						° ′ ″	°
23	I 2	D	21.6553	17.3987	— 19	—1.3	+ .3	40 34 35.34	+ 1 47.59	— 2	— 17	+ 4	9	40 36 23.87	
	3		27.7150	13.6193	+ 80	+ .9	— .6	40 42 19.93	— 5 56.64	+ 6	+ 7	—10	6	23.38	
	4		17.3803	20.7050	— 27	—1.2	— .7	40 37 47.41	— 1 24.00	+ 2	— 28	— 3	7	23.19	24.8
	5		16.6607	25.1977	+ 68	+ .2	— .8	40 32 46.92	+ 3 36.04	— 4	+ 13	+ 7	7	23.19	24.2
	6		23.5260	16.5450	+ 1	+1.0	+2.0	40 33 26.16	+ 2 56.53	— 3	+ 41	+ 5	6	23.18	
	7		28.7133	12.9107	+ 112	—1.1	—1.4	40 43 4.33	— 6 39.88	+ 7	— 35	—12	7	24.12	
	8		23.3290	16.5903	— 4	+ .1	+1.0	40 33 32.52	+ 2 50.39	— 3	+ 14	+ 5	6	23.13	24.4
	9		22.5357	17.5483	+ 2	+1.3	+ .5	40 38 28.19	— 2 6.12	+ 2	+ 27	— 4	7	23.39	
Dec.	10		9.4103 ii	31.2567 iv	+ 4	+1.9	+ .4	40 27 9.55	+ 9 12.43	+1.15	+ 35	+20	9	23.77	24.4
27	I 1	R	12.6830	27.9537	+ 42	+2.9	+1.7	40 42 48.58	— 6 26.25	+ 7	+ 68	—13	8	23.03	17.8
	2		18.5187	22.7807	+ 21	.0	— .3	40 34 35.71	+ 1 47.83	— 2	— 4	+ 4	9	23.61	
	3		13.3250	27.4487	— 46	+1.9	+1.5	40 42 20.32	— 5 57.26	+ 6	+ 49	—10	6	23.57	18.4
	4		23.7157	20.3860	+ 59	+2.4	+1.0	40 37 47.78	— 1 24.35	+ 2	+ 51	— 3	7	24.00	18.2
	5		24.3573	15.8163	+ 6	—1.9	— .2	40 32 47.25	+ 3 35.99	— 4	— 33	+ 7	7	23.01	
	6		16.2430	23.2077	— 19	+2.1	+2.0	40 33 26.49	+ 2 56.07	— 3	+ 59	+ 5	6	23.23	
	7		12.9983	28.8710	+ 131	+ .5	+2.2	40 43 4.63	— 6 41.70	+ 7	+ 36	—13	7	23.30	18.3
	8		17.4077	24.1670	+ 46	+ .7	+ .9	40 33 32.79	+ 2 51.04	— 3	+ 23	+ 5	6	24.14	
	9		17.5133	22.4287	— 2	—2.7	— .7	40 38 28.41	— 2 4.29	+ 2	— 52	— 4	7	23.65	a
Dec.	10		29.9113 iv	8.0893 ii	— 16	—1.1	+ .5	40 27 9.72	+ 9 11.77	+1.15	— 11	+20	9	22.82	18.5
28	I 1	D	27.4567	12.1920	— 24	— .1	+ .9	40 42 48.71	— 6 25.94	+ 7	+ 10	—13	8	22.89	11.8
	2		21.7910	17.5467	— 13	—1.6	+ .1	40 34 35.84	+ 1 47.29	— 2	— 24	+ 4	9	23.00	
	3		27.5537	13.5117	+ 65	— .3	—2.8	40 42 20.46	— 5 55.21	+ 6	— 41	—10	6	[24.83]	c
	4		17.9263	21.2357	— 14	—1.0	—1.8	40 37 47.91	— 1 23.65	+ 2	— 39	— 3	7	23.93	12.7
	5		15.7367	24.2853	+ 2	+1.7	— .1	40 32 47.38	+ 3 36.17	— 4	+ 26	+ 7	7	23.91	
	6		22.3817	15.3710	— 68	—3.0	—1.6	40 33 26.62	+ 2 57.11	— 3	— 68	+ 5	6	23.13	
	7		25.7943	9.9383	—295	+ .5	.0	40 43 4.75	— 6 40.21	+ 7	+ 8	—12	7	24.64	12.7
	8		23.6317	16.9030	+ 15	—1.5	— .3	40 33 32.90	+ 2 50.18	— 3	— 28	+ 5	6	22.88	11.6
	9		22.7480	17.3887	+ 3	+1.9	+1.8	40 38 28.51	— 2 15.53	+ 2	+ 53	— 4	7	[13.56]	*
Dec.	10		8.9723 ii	30.8243 iv	— 1	— .5	—1.2	40 27 9.81	+ 9 12.56	+1.15	— 23	+20	9	23.58	12.5
31	I 1	R	13.7370	28.9680	+ 185	— .4	— .5	40 42 49.14	— 6 25.61	+ 7	— 13	—13	8	23.42	19.9
	2		18.6120	22.8310	+ 26	+ 2.4	+2.2	40 34 36.26	+ 1 46.75	— 2	+ 66	+ 4	9	23.78	
	3		12.8343	26.9697	— 14	—2.2	—1.8	40 42 20.91	— 5 57.40	+ 6	— 58	—10	6	22.95	
	4		23.4330	20.0983	+ 52	+ .5	— .1	40 37 48.34	— 1 24.46	+ 2	+ 6	— 3	7	24.00	18.7
	5		23.3743	14.8313	— 66	—1.9	— .1	40 32 47.80	+ 3 35.86	— 4	— 32	+ 7	7	23.44	
	6		15.4587	22.4487	— 64	+ .2	— .2	40 33 27.05	+ 2 56.59	— 3	0	+ 5	6	23.72	18.8
	7		12.3710	28.2320	+ 41	—1.2	— .0	40 43 5.15	— 6 41.18	+ 7	— 19	—12	7	23.80	18.6
	8		15.7540	22.4727	— 53	+ .6	+ .6	40 33 33.29	+ 2 49.76	— 3	+ 17	+ 5	6	23.30	
1895	9		16.2697	21.2537	— 56	— .9	— .3	40 38 28.88	— 2 5.89	+ 2	— 18	— 4	7	22.86	18.5
Jan.	10		32.4810 iv	10.6620 ii	+ 26	— .4	+ .2	40 27 10.14	+ 9 11.80	+1.15	— 4	+20	9	23.34	18.6
I	I 1	D	27.3300	12.0493	— 41	+ .1	+ .7	40 42 49.26	— 6 26.30	+ 7	+ 10	—13	8	23.08	19.4
	2		17.3180	13.0863	—197	—3.9	— .5	40 34 36.38	+ 1 46.51	— 2	— 69	+ 4	9	22.31	
	3		26.7593	12.5883	— 40	+2.7	+ .9	40 42 21.05	— 5 58.24	+ 6	+ 55	—10	6	23.38	
	4		17.8997	21.2520	— 13	+1.1	— .7	40 37 48.45	— 1 24.74	+ 2	+ 8	— 3	7	23.85	19.9
	5		15.0610	23.6130	— 50	+ .7	+ .2	40 32 47.90	+ 3 36.13	— 4	+ 13	+ 7	7	24.26	
	6		23.1087	16.1227	— 24	— .8	— .2	40 33 27.19	+ 2 56.59	— 3	— 15	+ 5	6	23.71	
	7		26.6927	10.8273	—171	— .8	—1.1	40 43 5.29	— 6 40.75	+ 7	— 27	—12	7	24.29	19.7
	8		22.4273	15.7037	— 56	—1.6	— .5	40 33 33.41	+ 2 49.88	— 3	— 32	+ 5	6	23.05	19.2
	9		21.8467	16.8377	— 30	+ .1	+ .1	40 38 28.99	— 2 6.59	+ 2	+ 3	— 4	7	22.48	
Jan.	10		7.9410 ii	29.7537 iv	— 31	+ .4	+ .3	40 27 10.25	+ 9 11.50	+1.15	+ 10	+20	9	23.29	19.1
4	I 1	R	12.7233	28.0137	+ 48	+1.2	+ .2	40 42 49.52	— 6 26.77	+ 7	+ 22	—13	8	22.99	16.9
	2		20.9373	25.1270	+111	— .6	—1.6	40 34 36.64	+ 1 46.22	— 2	— 30	+ 4	9	22.67	
	3		12.8260	26.9897	— 12	— .8	— .4	40 42 21.34	— 5 58.12	+ 6	— 18	—10	6	23.06	
	4		22.1183	18.7570	+ 12	— .5	—1.9	40 37 48.72	— 1 25.03	+ 2	— 32	— 3	7	23.43	
	5		25.2397	16.7280	+ 72	+ .2	+1.1	40 32 48.20	+ 3 35.42	— 4	+ 17	+ 7	7	23.89	17.4
	6		15.9023	22.8207	— 39	+5.8	+5.4	40 33 27.48	+ 2 54.85	— 3	+1.62	+ 5	6	24.03	

* Definition this evening very poor; work not satisfactory.

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Jan.								° ′ ″						° ′ ″	°
4	I 7	R	12.0480	27.9453	0	— .8	+ .3	40 43 5.54	— 6 41.99	+ 7	— 9	—12	7	40 36 23.48	
	8		16.6873	23.3590	+ 1	+ .9	+ .1	40 33 33.68	+ 2 48.71	— 3	+ 16	+ 5	6	22.63	16.0
	9		17.9463	22.9763	+ 21	— .1	+ .3	40 38 29.24	— 2 7.25	+ 2	+ 2	— 4	7	22.06	
Jan.	10		32.8960iv	11.1133 ii	+ 33	— .3	+ .7	40 27 10.47	+ 9 10.90	+1.08	+ 4	+20	9	22.78	16.5
11	I 1	D	28.1667	12.8743	+ 68	— .7	— .8	40 42 50.18	— 6 26.87	+ 7	— 21	—13	8	23.12	34.4
	2		22.0477	17.8537	— 3	—1.5	— .2	40 34 37.29	+ 1 46.05	— 2	— 26	+ 4	9	23.19	
	3		27.6940	13.4890	+ 75	+3.1	+1.7	40 42 22.07	— 5 59.39	+ 6	+ 71	—10	6	23.41	
	4		17.7473	21.1730	— 17	+1.2	+ .2	40 37 49.40	— 1 26.58	+ 2	+ 22	— 3	7	23.10	
	5		15.6443	24.1290	— 7	.0	.0	40 32 48.85	+ 3 34.53	— 4	0	+ 7	7	23.48	34.1
	6		21.6757	14.7347	—128	— .8	.0	40 33 28.15	+ 2 55.24	— 3	— 13	+ 5	6	23.34	34.1
	7		27.6503	11.7157	— 46	— .6	+ .7	40 43 6.16	— 6 42.82	+ 7	— 19	—12	7	23.17	33.9
	8		23.4493	16.7647	+ 5	— .6	+ .3	40 33 34.27	+ 2 49.04	— 3	— 5	+ 5	6	23.34	
	9		22.6323	17.6030	+ 5	+1.1	+1.9	40 38 29.79	— 2 7.19	+ 2	+ 42	— 4	7	23.07	
Jan.	10		9.0183 ii	30.7967iv	— 1	+1.1	+ .7	40 27 10.93	+ 9 10.70	+1.08	+ 26	+20	9	23.26	33.8
14	I 2	R	17.3153	21.4750	— 23	+ .6	.0	40 34 37.69	+ 1 45.13	— 2	+ 9	+ 4	9	23.02	23.1
	4		22.3587	18.9407	+ 21	+1.7	+ .2	40 37 49.83	— 1 26.48	+ 2	+ 30	— 3	6	23.70	22.8
	5		23.5180	15.0660	— 52	— .7	+ .8	40 32 49.28	+ 3 33.59	— 4	— 1	+ 7	7	22.96	
	7		13.4530	29.3813	+197	—1.5	+ .8	40 43 6.58	— 6 43.27	+ 7	— 14	—12	7	23.19	22.4
	8		16.3900	23.0763	— 17	+ .1	— .5	40 33 34.70	+ 2 49.03	— 3	— 5	+ 5	6	23.76	
	9		17.2883	22.3177	— 9	—1 9	— .5	40 38 30.20	— 2 7.15	+ 2	— 37	— 4	7	22.73	
Jan.	10		30.3397iv	8.5730 ii	— 8	— .3	+ .4	40 27 11.30	+ 9 10.39	+1.08	0	+20	9	23.06	22.4
16	I 1	D	27.7560	12.4147	+ 10	+2.0	+ .7	40 42 50.79	— 6 27.96	+ 7	+ 41	—13	8	23.26	31.3
	2		22.0300	17.8737	— 2	— .5	.0	40 34 37.86	+ 1 45.09	— 2	— 8	+ 4	9	22.98	31.4
	3		28.0220	13.7917	+111	+1.6	+1.5	40 42 22.61	— 6 0.12	+ 6	+ 45	—10	6	22.96	
	4		16.3370	19.7907	— 59	+ .8	— .4	40 37 49.86	— 1 27.18	+ 2	+ 8	— 3	7	22.82	31.1
	5		17.3683	25.8183	+116	+1.0	— .3	40 32 49.50	+ 3 33.97	— 4	+ 12	+ 7	7	23.69	
	6		22.4147	15.5040	— 64	— .1	.0	40 33 28.84	+ 2 54.59	— 3	— 1	+ 5	6	23.50	
	7		26.7190	10.7427	—181	+1.5	+1.9	40 43 6.82	— 6 43.53	+ 7	+ 48	—12	7	23.79	
	8		22.4483	15.8057	— 51	— .5	+ .2	40 33 34.94	+ 2 47.84	— 3	— 5	+ 5	6	22.81	30.6
	9		22.5500	17.4918	+ 1	+1.8	+2.4	40 38 30.43	— 2 7.92	+ 2	+ 59	— 4	7	23.15	
Jan.	10		8.6340 ii	30.3773iv	— 10	+1.6	+ .9	40 27 11.52	+ 9 9.79	+1.01	+ 37	+20	9	22.98	30.7
19	I 1	R	10.7857	26.1690	—206	+2.7	+ .9	40 42 50.98	— 6 28.47	+ 7	+ 55	—13	8	23.08	21.5
	2		18.1623	22.3303	+ 9	—2.3	—3.3	40 34 38.10	+ 1 45.42	— 2	— 79	+ 4	9	22.84	
	3		13.0197	27.2393	+ 17	—3.0	— .7	40 42 22.97	— 5 59.61	+ 6	— 57	—10	6	22.81	
	4		21.0013	17.5693	— 22	— .4	—1.8	40 37 50.28	— 1 26.73	+ 2	— 29	— 3	7	23.32	21.5
	5		24.7470	16.2933	+ 38	—2.7	— .9	40 32 49.74	+ 3 33.86	— 4	— 55	+ 7	7	23.15	21.5
	6		17.0123	23.9127	+ 28	+ .8	— .1	40 33 29.09	+ 2 54.56	— 3	+ 11	+ 5	6	23.84	
	7		12.6543	28.6260	+ 89	— .4	+2.1	40 43 6.98	— 6 44.10	+ 7	+ 20	—12	7	23.10	21.1
	8		16.5393	23.1927	— 10	+ .2	— .3	40 33 35.18	+ 2 48.22	— 3	— 1	+ 5	6	23.47	
	9		18.5667	23.5733	+ 48	—1.1	— .8	40 38 30.67	— 2 6.72	+ 2	— 27	— 4	7	23.73	
Jan.	10		31.3033iv	9.5243 ii	+ 4	—2.2	—1.5	40 27 11.73	+ 9 10.73	+1.01	— 54	+20	9	23.22	21.3
23	I 1	D	28.1487	12.8023	— 63	+1.4	.0	40 42 51.29	— 6 28.22	+ 7	+ 22	—13	8	23.31	21.8
	2		19.9607	15.8017	— 78	—1.1	.0	40 34 38.42	+ 1 44.97	— 2	— 17	+40	9	23.69	
	3		27.9597	13.7597	+105	+ .8	— .7	40 42 23.32	— 5 59.34	+ 6	+ 4	—10	6	24.04	
	4		17.0320	20.4847	— 36	—1.5	— .2	40 37 50.63	— 1 27.22	+ 2	— 26	— 3	7	23.21	
	5		15.8827	24.3203	+ 8	+ .7	+1,0	40 32 50.08	+ 3 33.38	— 4	+ 24	+ 7	7	23.80	20.9
	6		23.9107	17.0240	+ 28	— .6	.0	40 33 29.46	+ 2 54.21	— 3	— 9	+ 5	6	23.66	
	7		27.4107	11.4513	— 80	— .2	+ .1	40 43 7.41	— 6 43.36	+ 7	— 2	—12	7	24.05	21.0
	8		21.6423	14.9897	— 98	—3.1	— .7	40 33 35.54	+ 2 47.97	— 3	— 59	+ 5	6	23.00	21.0
	9		22.2260	17.1660	— 15	+ .5	.0	40 38 31.01	— 2 7.91	+ 2	+ 8	— 4	7	23.23	20.6
Jan.	10		9.3280 ii	31.0920iv	+ 1	— .4	—1.9	40 27 12.02	+ 9 10.34	+1.01	— 31	+20	9	23.35	
24	I 1	R	12.8830	28.2007	+ 74	+ .1	— .8	40 42 51.40	— 6 27.52	+ 7	— 8	—13	8	23.82	18.6
	2		19.4427	23.5967	+ 56	—1.7	—2.3	40 34 38.54	+ 1 45.18	— 2	— 57	+ 4	9	23.26	
	3		12.4887	26.7293	— 48	—1.0	— .8	40 42 23.45	— 5 59.98	+ 6	— 26	—10	6	23.23	
	4		22.7650	19.3170	+ 30	+1.1	— .1	40 37 50.76	— 1 27.26	+ 2	+ 16	— 3	7	23.72	18.6

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. t	Corrections. r	Corrections. Mer	Latitude.	Ther. mom.
Jan.								° ′ ″						° ′ ″	°
24	I 5	R	23.9523	16.5090	+ 13	—3.0	—1.1	40 32 50.20	+ 3 33.54	- 4	- 62	+ 7	7	40 36 23.22	
	6		13.9720	20.9187	—156	—4.1	—4.7	40 33 29.59	+ 2 55.26	- 3	—1.26	+ 5	6	23.67	
	7		12.9543	28.9067	+129	—1.2	+ .6	40 43 7.53	— 6 43.71	+ 7	- 12	-12	7	23.72	18.5
	8		15.0560	21.6917	— 95	+ .6	+1.0	40 33 35.67	+ 2 47.56	-- 3	+ 22	+ 5	6	23.53	18.4
	9		17.9413	23.0197	— 21	— .6	+ .6	40 38 31.14	— 2 8.36	+ 2	- 2	- 4	7	22.81	
Jan.	10		31.8540 iv	10.1080 ii	+ 15	—1.5	— .7	40 27 12.14	+ 9 9.92	+1.01	— 33	+ 20	9	23.03	18.3
27	I 1	D	28.6000	13.2353	+124	— .6	— .2	40 42 51.78	— 6 28.84	+ 9	-- 12	—13	8	22.86	23.6
	2		23.1777	19.0533	+ 40	— .3	.0	40 34 38.92	+ 1 44.39	— 2	— 5	+ 4	9	23.37	
	3		32.6637	18.4813	+690	— .0	— .9	40 42 23.87	— 6 0.37	+ 9	— 11	-10	6	23.44	
	4		18.9573	22.4080	+ 22	+ .4	— .2	40 37 51.18	— 1 27.31	+ 2	+ 4	— 3	7	23.97	23.1
	5		15.1823	23.5960	— 53	+ .3	+ .6	40 32 50.63	+ 3 32.62	— 5	+ 12	+ 7	7	23.46	
	6		22.8593	16.0010	— 34	+ .6	+ .9	40 33 30.04	+ 2 53.34	— 4	+ 21	+ 5	6	23.66	
	7		26.0500	10.0343	—275	+ .3	+ .4	40 43 7.97	— 6 44.29	+ 10	+ 10	—13	7	23.82	23.1
	8		22.5777	15.9770	— 40	—1.2	— .1	40 33 36.12	+ 2 46.81	-- 4	- 21	+ 5	6	22.79	
	9		21.4150	16.3247	— 53	+ .9	+1.1	40 38 31.58	— 2 8.59	+ 3	+ 28	- 4	7	23.33	
	10		8.2177 ii	29.9533 iv	— 14	+ .2	— .5	40 27 12.55	+ 9 9.59	-+ 98	— 3	+ 20	9	23.38	22.9
	II 1	D	15.8943	21.5843	— 64	— .7	.0	40 38 47.07	— 2 23.72	+ 4	— 11	— 4	6	23.30	19.2
	2		21.5067	17.1023	— 28	— .3	—1.5	40 38 15.13	— 1 51.30	-+ 3	- 24	-- 3	6	23.65	
	3		21.0307	17.8680	— 16	— .2	+ .6	40 35 3.66	+ 1 19.93	— 2	+ 4	+ 3	6	23.70	19.5
	4		19.9253	18.4800	— 11	.0	.0	40 36 59.48	— 36.52	+ 1	0	— 1	7	23.03	19.2
	5		17.9253	17.5993	— 7	+ .4	+ .4	40 36 15.19	+ 8.23	— 0	+ 11	0	8	23.61	
	6		32.1860 iv	9.9473 ii	+ 21	— .9	—1.1	40 45 47.03	— 9 22.40	- 97	— 28	—16	6	23.28	
	7		15.0667	26.2270	+ 63	— .7	— .1	40 41 5.03	— 4 42.37	+ 7	— 12	— 8	6	22.59	19.0
Jan.	8		7.9793 ii	29.3463 iv	— 14	+ .5	+2.2	40 27 21.90	+ 9 0.27	+ 98	+ 36	+18	8	23.77	19.4
29	I 1	R	10.7350	26.1497	—209	+1.0	+1.2	40 42 51.97	— 6 29.25	+ 9	+ 31	—13	8	23.07	20.1
Jan.	2		17.1220	21.2527	— 31	— .5	—1.1	40 34 39.13	+ 1 44.37	— 2	— 22	+ 4	9	23.39	
31	I 1	R	12.0117	27.4050	— 39	+2.0	+ .9	40 42 52.09	— 6 29.15	+ 9	+ 43	—13	8	23.41	15.5
	2		21.4953	25.5917	+128	— .2	— .6	40 34 39.26	+ 1 43.91	— 2	— 10	+ 4	9	23.18	
	3		12.3113	26.5757	— 69	—2.0	— .6	40 42 24.26	— 6 0.53	+ 9	— 39	—10	6	23.39	
	4		22.5010	19.0627	+ 24	—1.5	—2.6	40 37 51.57	— 1 27.00	+ 2	-- 57	— 3	7	24.06	
	5		23.6550	15.2493	— 39	— .1	+ .2	40 32 51.04	+ 3 32.43	— 5	+ 1	+ 7	7	23.57	16.1
	6		17.6210	24.4347	+ 60	+2.4	+1.9	40 33 30.49	+ 2 52.45	- 4	+ 63	+ 5	6	23.64	
	7		11.8893	27.8960	— 14	— .4	+ .6	40 43 8.41	— 6 44.72	+ 10	+ 1	—13	7	23.71	16.1
	8		16.4380	23.0180	— 16	+1.1	+ .6	40 33 36.61	+ 2 46.34	- 4	+ 28	+ 5	6	23.30	15.7
	9		17.6633	22.7730	+ 10	+ .8	— .8	40 38 32.06	— 2 9.23	+ 3	+ 3	— 4	7	22.92	
	10		30.3100 iv	8.5940 ii	— 8	— .5	+ .6	40 27 13.01	+ 9 9.11	+ 98	0	+ 20	9	23.39	16.3
	II 1	R	22.4637	16.7440	— 21	+ .6	+ .2	40 38 46.80	— 2 24.58	+ 4	+ 12	- 4	6	22.40	10.1*a*
	2		15.8703	20.3123	— 73	+2.8	+2.3	40 38 14.82	— 1 52.14	+ 3	+ 74	— 3	6	23.48	
	3		18.4393	21.6007	— 2	+1.2	+1.2	40 35 3.29	+ 1 19.94	— 2	+ 35	+ 3	6	23.65	10.7
	4		21.8863	23.3047	+ 32	— .3	+ .8	40 36 59.09	— 35.95	+ 1	+ 5	— 1	7	23.26	
	5		21.4587	21.7863	+ 5	.0	— .5	40 36 14.76	+ 8.30	— 0	— 6	0	8	23.08	
	6		9.4237 ii	31.5883 iv	+ 8	—2.5	—3.1	40 45 46.54	— 9 20.49	- 97	— 79	—16	6	24.19	
	7		25.6877	14.5387	+ 9	+ .7	+ .6	40 41 4.47	— 4 41.94	+ 7	+ 18	8	6	22.76	10.0
	8		30.5783 iv	9.2253 ii	— 1	+1.0	+2.3	40 27 21.36	+ 8 59.95	+ 98	+ 45	+ 18	8	23.00	
	9		22.2980	18.3067	+ 10	.0	+ .5	40 34 43.05	+ 1 40.95	— 2	+ 2	+ 3	6	24.09	9.7
Feb															
2	I 1	D	27.6977	12.3043	0	+1.5	+ .9	40 42 52.17	— 6 29.25	+ 9	+ 35	—13	8	23.31	18.2
	2		20.6353	16.5093	— 53	— .6	— .6	40 34 39.36	+ 1 44.20	— 2	— 17	+ 4	9	23.50	
	3		26.3453	12.0487	— 99	+1.9	.0	40 42 24.37	— 6 1.26	+ 9	+ 30	—10	6	23.46	17.8
	4		15.9030	19.3763	— 72	—2.3	—2.0	40 37 51.69	— 1 27.65	+ 2	— 62	— 3	7	23.48	
	5		17.9807	26.3413	+159	+2.2	+1.7	40 32 51.17	+ 3 31.81	- 5	+ 57	+ 7	7	23.64	17.4
	6		23.3257	16.4673	— 8	—3.3	—1.5	40 33 30.63	+ 2 53.41	— 4	- 72	+ 5	6	23.39	
	7		25.2257	9.1673	—395	— .3	+1.5	40 43 8.55	— 6 45.07	+ 10	+ 14	—13	7	23.66	
	8		22.5727	15.9643	— 42	— .8	— .7	40 33 36.76	+ 2 47.00	— 4	— 22	+ 5	6	23.61	16.0
	9		21.1257	15.9870	— 67	— .2	— .2	40 38 32.22	— 2 9.77	+ 3	— 5	— 4	7	22.46	
	10		7.8630 ii	29.5847 iv	— 18	— .7	—2.0	40 27 13.15	+ 9 9.23	+ 98	— 36	+20	9	23.29	16.6

1895.	Star.		P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Feb.									° ′ ″						° ′ ″	°
2	II	1	D	12.2620	17.9823	—246	+1.2	+1.1	40 38 46.67	— 2 24.03	+ 4	+ 33	— 4	6	40 36 23.03	11.4
		2		21.6283	17.2390	— 24	—1.2	— .7	40 38 14.68	— 1 50.93	+ 3	— 28	— 3	6	23.53	
		3		21.3300	18.1550	— 8	—1.7	—1.2	40 35 3.12	+ 1 20.27	— 2	— 43	+ 3	6	23.03	11.5
		4		20.6430	19.2583	— 1	—1.2	.0	40 36 58.91	— 35.01	+ 1	— 19	— 1	7	23.78	11.4
		6		32.3313[iv]	10.1273[ii]	+ 24	+1.4	+ .6	40 45 46.33	— 9 21.53	— 97	+ 30	—16	6	24.03	
		7		12.8067	23.9533	—159	—2.7	—1.2	40 41 4.23	— 4 41.46	+ 7	— 59	— 8	6	22.23	11.1
		8		11.9183[ii]	33.3260[iv]	+ 32	—2.4	—1.9	40 27 21.12	+ 9 1.41	+ 98	— 63	+18	8	23.14	
		9		18.5373	22.4990	+ 18	— .6	— .8	40 34 42.81	+ 1 40.22	— 2	— 19	+ 3	6	22.91	
Mar.		10		13.3250	29.8420	+228	—1.2	—2.6	40 29 26.74	+ 6 58.24	— 10	— 53	+12	5	[24.52]	9.9*
3	I	1	R	12.2473	27.6790	— 4	+ .6	—1.0	40 42 53.57	— 6 30.21	+ 9	— 3	—13	8	23.37	36.8
		2		18.6880	22.7387	+ 25	— .6	—1.4	40 34 41.01	+ 1 42.49	— 2	— 27	+ 4	9	23.34	
		3		12.5803	26.9643	— 28	— .7	+ .4	40 42 26.32	— 6 3.65	+ 9	— 6	—10	6	22.66	
		4		22.3317	18.7803	+ 17	+1.4	+ .4	40 37 53.74	— 1 29.85	+ 2	+ 27	— 3	7	24.22	36.6
		5		24.4600	16.1720	+ 23	+ .7	+1.7	40 32 53.38	+ 3 29.63	— 5	+ 33	+ 7	7	23.43	
		6		15.5470	22.3117	— 65	— .4	— .8	40 33 33.12	+ 2 50.89	— 4	— 16	+ 5	6	23.92	
		7		12.3530	28.4517	+ 55	—1.2	+ .2	40 43 11.05	— 6 47.22	+ 10	— 17	—13	7	23.70	36.4
		8		16.4237	22.9050	— 21	+ .4	+ .4	40 33 39.63	+ 2 43.84	— 4	+ 11	+ 5	6	23.65	35.9
		9		17.9977	23.2097	+ 28	+ .4	+ .4	40 38 35.12	— 2 11.87	+ 3	+ 11	— 4	7	23.42	
Mar.		10		32.6640[iv]	9.0860[ii]	+ 27	+ .2	+ .9	40 27 15.90	+ 9 5.71	+ 98	+ 14	+20	9	23.02	35.3
5	I	1	D	27.3560	11.9300	— 47	+ .2	— .9	40 42 53.60	— 6 29.95	+ 9	— 8	—13	8	23.61	27.3
		2		21.7860	17.7160	— 9	—3.4	—2.2	40 34 41.06	+ 1 42.89	—	— 82	+ 4	9	23.24	
		3		27.8133	13.4457	+ 78	+2.9	+1.0	40 42 26.39	— 6 3.51	+ 9	+ 59	—10	6	23.52	
		4		17.3173	20.9617	— 28	—1.3	—1.4	40 37 53.82	— 1 32.08	+ 2	— 39	— 3	7	[21.41]	†
		5		15.3497	23.6647	— 35	+ .7	+ .2	40 32 53.46	+ 3 30.17	— 5	+ 13	+ 7	7	23.85	27.0
		6		22.4010	15.6770	— 56	.0	+ .6	40 33 33.22	+ 2 49.89	— 4	+ 7	+ 5	6	23.25	
		7		28.1730	12.0843	+ 15	+ .9	.0	40 43 11.15	— 6 46.87	+ 10	+ 14	—13	7	24.46	26.7
Mar.		10		8.8650[ii]	30.4510[iv]	— 8	+1.1	.0	40 27 16.04	+ 9 5.83	+ 98	+ 17	+20	9	23.31	26.7
6	I	1	R	12.5470	28.0190	+ 37	+1.7	+1.2	40 42 53.64	— 6 31.33	+ 9	+ 43	—13	8	22.78	34.9
		3		12.6267	26.9953	— 26	— .3	+ .6	40 42 26.33	— 6 3.27	+ 9	+ 2	—10	6	23.13	
		4		23.3123	19.7583	+ 47	—1.6	—1.5	40 37 53.89	— 1 29.99	+ 2	— 44	— 3	7	23.52	34.8
Mar.																
9	I	1	D	25.0603	9.5817	—362	— .1	— .1	40 42 53.78	— 6 30.49	+ 9	— 3	—13	8	23.30	32.4
		2		21.6117	17.5830	— 16	—1.0	—1.4	40 34 41.28	+ 1 41.83	— 2	— 34	+ 4	9	22.88	
		3		26.3027	11.9287	—112	+1.5	+1.2	40 42 26.62	— 6 3.19	+ 9	+ 39	—10	6	23.87	
		4		14.8247	18.4367	—106	+1.2	+ .6	40 37 54.09	— 1 31.07	+ 2	+ 27	— 3	7	23.35	
		5		16.3457	24.6377	+ 33	+ .5	.0	40 32 53.76	+ 3 29.76	— 5	+ 8	+ 7	7	23.69	32 6
		6		23.5247	16.7937	+ 9	—1.8	— .8	40 33 33.56	+ 2 50.23	— 4	— 39	+ 5	6	23.47	
		7		27.8980	11.7807	— 23	+ .4	— .1	40 43 11.51	— 6 47.50	+ 10	+ 5	—13	7	24.10	32.9
		8		23.5583	17.1097	+ 19	— .9	+ .6	40 33 40.17	+ 2 43.11	— 4	— 7	+ 5	6	23.28	
		9		22.3167	17.0960	— 14	— .4	+ .5	40 38 35.68	— 2 11.98	+ 3	0	— 4	7	23.76	
		10		9.3283[ii]	30.8897[iv]	+ 1	+1.1	— .7	40 27 16.33	+ 9 5.22	+ 98	+ 8	+19	9	22.89	33.4
Mar.																
10	I	1	R	11.4433	26.9020	—113	— .1	—1.0	40 42 53.80	— 6 30.61	+ 9	— 18	—13	8	23.05	45.8
		2		18.2213	22.2463	+ 8	—1.2	—1.0	40 34 41.30	+ 1 41.80	— 2	— 32	+ 4	9	22.89	
		3		12.5077	26.8867	— 40	+ .6	+ .8	40 42 26.67	— 6 3.50	+ 9	+ 19	—10	6	23.41	44.9
		4		23.2097	19.6057	+ 43	+1.0	+ .2	40 37 54.14	— 1 31.24	+ 2	+ 18	— 3	7	23.14	
		6		18.6473	25.3220	+115	+3.3	+2.2	40 33 33.64	+ 2 49.07	— 4	+ 81	+ 5	6	23.59	45.5
Mar.																
14	I	2	D	24.6397	20.6043	+ 91	+ .1	+ .2	40 34 41.30	+ 1 42.27	— 2	+ 4	+ 4	9	23.72	26.9*a*
		3		27.1607	12.7487	— 7	+1.8	+1.8	40 42 26.63	— 6 4.41	+ 9	+ 52	—10	6	22.79	
		4		17.1740	20.8133	— 33	—1.0	+ .2	40 37 54.14	— 1 31.94	+ 2	+ 18	— 3	7	22.44	26.9
16	II	1	R	22.4267	16.6587	— 24	+ .5	+ .9	40 38 48 23	— 2 25.79	+ 4	+ 19	— 4	6	23.69	26.0
		2		17.2900	21.7560	— 19	+ .5	+1.5	40 38 16.00	— 1 52.88	+ 3	+ 27	— 3	6	23.45	
		3		18.6987	21.8340	+ 6	+1.0	+1.2	40 35 3.81	+ 1 19.30	— 2	+ 31	+ 3	6	23.49	25.9
		4		20.0117	21.4213	+ 8	—2.3	— .5	40 36 59.17	— 35 66	+ 1	— 44	— 1	7	23.14	
		5		22.0350	22.3830	+ 8	+ .7	+ .1	40 36 14.36	+ 8.82	— 0	+ 12	0	8	23.38	
		6		12.1123[ii]	34.2917[iv]	+ 63	—1.3	— .4	40 45 46 06	— 9 21.00	— 97	— 26	—16	6	23.73	25.6
		7		25.4823	14.3967	— 4	+ .4	—1.3	40 41 3.31	— 4 40.31	+ 7	— 10	— 8	6	22.95	

* Observation unsatisfactory. † Light bad; observation hurried.

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
								° ′ ″						° ′ ″	°
Mar. 16	II 8	R	30.4617	9.0060	— 2	—1.7	— .6	40 27 19.88	+ 9 2.54	+ 98	— 35	+ 18	8	40 36 23.31	26.0
	9		22.4250	18.3803	+ 14	— .8	— .8	40 34 41.25	+ 1 42.31	— 2	— 23	+ 3	6	23.40	
Mar. 17	10		28.0770	11.5073	— 31	—2.3	—1.5	40 29 24.64	+ 6 58.92	— 10	— 56	+ 12	6	23.08	25.9
	I 3	R	12.6167	27.0033	— 7	+ 1.4	+ 1.6	40 42 26.60	— 6 3.77	+ 9	+ 43	—10	6	23.31	33.5
	4		21.3403	17.7350	— 15	+ 1.9	+ .5	40 37 54.13	— 1 31.13	+ 2	+ 37	— 3	7	23.43	
	5		24.7830	16.5123	+ 45	—1.0	— .4	40 32 53.88	+ 3 29.25	— 5	— 21	+ 7	7	23.01	
	6		17.2957	23.9987	+ 38	+ .2	+ 1.0	40 33 33.76	+ 2 49 59	— 4	+ 16	+ 5	6	23.58	33.1
	7		11.8850	28.0240	— 8	—1.0	.0	40 43 11.74	— 6 48.08	+ 10	— 16	—13	7	23.54	32.6
	8		17.2843	23.7133	+ 29	+ 1.3	+ .5	40 33 40.56	+ 2 42.64	— 4	+ 27	+ 5	6	23.54	32.4
	9		16.9730	22.2447	— 17	— .9	.0	40 38 36.10	— 2 13.26	+ 3	— 14	— 4	7	22.76	
	10		31.6627 iv	10.1143 ii	+ 11	— .6	+ 5	40 27 16.88	+ 9 4.92	+ 98	— 3	+ 20	9	23.04	31.8
	II 1	D	15.2007	20.9533	— 97	+ .9	+ 1.0	40 38 48.36	— 2 25.22	+ 4	+ 27	— 4	6	23.47	28.6
	2		21.4597	17.0043	— 30	+ .4	.0	40 38 16.13	— 1 52.59	+ 3	+ 6	— 3	6	23.66	
	3		20.9570	17.8377	— 17	.4	+ .2	40 35 3.94	+ 1 18.83	— 2	+ 9	+ 3	6	22.93	28.8
	4		23.4290	21.9887	+ 35	+ .9	+ .7	40 36 59.28	— 36.51	+ 1	+ 23	— 1	7	23.07	
	5		20.9400	20.6390	+ 2	+1.8	+1.1	40 36 14.46	+ 7.62	— 0	+ 43	0	8	22.59	
	6		30.8943 iv	8.6570 ii	- 5	+ 1.7	+2.1	40 45 46.17	— 9 22.30	— 97	+ 54	—16	6	23.34	
	7		13.3703	24.4960	—101	+ .8	+1.3	40 41 3.41	— 4 41.08	+ 7	+ 29	— 8	6	22.67	28.9
	8		8.3517 ii	29.7993 iv	— 11	+ 2.1	.0	40 27 19.96	+ 9 2.31	+ 98	+ 33	+ 18	8	23.84	
	9		18.1837	22.2187	+ 7	+ 1.7	+ .3	40 34 41.34	+ 1 42.05	— 2	+ 32	+ 3	6	23.78	
Mar. 18	10		11.8173	28.3390	+ 10	+ 2.6	+1.8	40 29 24.72	+ 6 57.81	— 10	+ 64	+ 12	6	23.25	30.2
	I 3	D	28.0747	13.7240	+ 112	+ 1.0	— .1	40 42 26.60	— 6 3.17	+ 9	+ 14	—10	6	23.62	38.5
	4		16.9647	20.5643	— 37	+ .7	+ .9	40 37 54.14	— 1 30.93	+ 2	+ 22	— 3	7	23.49	
	5		17.3750	25.6083	+ 107	+ .1	+ .6	40 32 53.89	+ 3 28.46	— 5	+ 7	+ 7	7	22.51	*
	6		23.7020	16.9940	+ 22	— .1	+ 1.	40 33 33.78	+ 2 49.68	— 4	0	+ 5	6	23.53	
	7		29.4277	13.3203	+ 192	+ .1	— .3	40 43 11.76	— 6 47.79	+ 10	— 2	—13	7	23.99	37.9
	8		23.1690	16.7407	— 4	— .7	+ .2	40 33 40.60	+ 2 42.54	— 4	+ 8	+ 5	6	23.29	37.7
	9		23.7880	18.5453	+ 54	— .6	— .7	40 38 36.14	— 2 12.71	+ 3	— 5	— 4	7	23.44	
	10		9.2433 ii	30.7753 iv	0	+ 2.3	+ .7	40 27 16.92	+ 9 4.47	+ 98	+ 46	+ 20	9	23.12	
	II 1	R	23.7623	18.0213	+ 46	+ .9	+ .2	40 38 48.48	— 2 25.29	+ 4	+ 17	— 4	6	23.42	33.1
	2		17.1533	21.6187	— 26	+ .4	— .3	40 38 16.25	— 1 52.85	+ 3	+ 2	— 3	6	23.48	
	3		19.3067	22.4300	+ 24	+ 1.5	+1.8	40 35 4.05	+ 1 19.04	— 2	+ 47	+ 3	6	23.63	32.6
	4		21.4093	22.8347	+ 28	—1.8	— .6	40 36 59.38	— 36.11	+ 1	— 36	- 1	7	22.98	
	5		21.4500	21.7903	+ 6	+ .6	+ .4	40 36 14.54	+ 8.62	— 0	+ 14	0	8	23.38	
	7		25.2077	14.1203	— 32	— .3	+ .1	40 41 3.49	— 4 40.28	+ 7	— 3	— 8	6	23.23	32.4
	8		32.0523 iv	10.6267 ii	+ 16	+ 1.1	+ 1.9	40 27 20.04	+ 9 1.82	+ 98	+ 42	+ 18	8	23.52	
	9		20.4513	16.4120	— 56	+ .2	+ .6	40 34 41.41	+ 1 42.00	— 2	+ 10	+ 3	6	23.58	
Mar. 19	10		28.7230	12.1987	+ 66	+ .4	+ .1	40 29 24.80	+ 6 58.01	— 10	+ 8	+ 12	6	22.97	31.8
	I 3	R	12.0263	26.4170	— 99	+ 1.5	+ .8	40 42 26.54	— 6 3.64	+ 9	+ 34	—10	6	23.29	39.8
	4		23.3787	19.7793	+ 51	+ 1.6	+ .7	40 37 54.15	— 1 31.15	+ 2	+ 35	— 3	7	23.41	39.8
	5		25.6827	17.4147	+ 112	—1.0	+ .3	40 32 53.91	+ 3 29.35	— 5	— 12	+ 7	7	23.23	
	6		18.2350	24.9093	+ 91	+ 2.9	+ 1.7	40 33 33.82	+ 2 49.00	— 4	+ 68	+ 5	6	23.57	
	7		11.7497	27.8927	— 25	+ .5	+ .5	40 43 11.81	— 6 48.14	+ 10	+ 16	—13	7	23.87	39.4
	8		16.6220	23.0667	— 11	+ .1	— .5	40 33 40.65	+ 2 42.94	— 4	— 6	+ 5	6	23.60	38.4
	9		18.0033	23.2800	+ 31	+ 1.9	+ 1.8	40 38 36.21	— 2 13.51	+ 3	+ 53	— 4	7	23.29	
Mar. 21	10		31.7987 iv	10.2510 ii	+ 13	— .8	+ .4	40 27 16.98	+ 9 4.90	+ 98	— 8	+ 19	9	23.06	38.1
	I 5	D	15.1410	23.4293	— 53	.0	— .2	40 32 53.96	+ 3 29.45	— 5	— 2	+ 7	7	23.48	35.4
	6		22.7027	16.0333	— 38	+ 1.8	+ 2.3	40 33 33.92	+ 2 48.55	— 4	+ 58	+ 5	6	23.12	
	7		27.9310	11.7730	— 25	— .2	+ .8	40 43 11.92	— 6 48.52	+ 10	— 13	+ 7	7	23.51	
	8		24.2203	17.8237	+ 58	+ .9	+2.0	40 33 40.79	+ 2 41.90	— 4	+ 40	+ 5	6	23.16	34.4
	9		22.1357	16.8437	— 24	+ 1.1	+ .6	40 38 36.36	— 2 13.76	+ 3	+ 25	— 4	7	22.91	
	10		8.7490 ii	30.2743 iv	— 6	+ 2.5	+ 1.9	40 27 17.14	+ 9 4.29	+ 98	+ 64	+ 19	9	23.33	34.5
	II 1	D	16.7303	22.5320	— 21	+ .8	+ 2.2	40 38 48.87	— 2 26.65	+ 4	+ 41	— 4	6	22.69	28.4
	2		22.2537	17.7503	— 0	+ 1.9	+ 1.1	40 38 16.63	— 1 53.88	+ 3	+ 44	— 3	6	23.25	
	3		22.3690	19.2720	— 23	+ .3	+ 1.1	40 35 4.39	+ 1 18.37	— 2	+ 19	+ 3	6	23.02	28.3

* Probably wrong star.

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Mar.								° ′ ″						° ′ ″	°
21	II 4	D	22.4203	20.9437	+ 22	+ .6	+ .8	40 36 59.67	— 37.39	+ 1	+ 19	— 1	7	40 36 22.54	
	5		20.0230	19.6970	— 1	—1.4	—1.1	40 36 14.80	+ 8.24	— 0	— 36	0	8	22.76	
	6		31.0887iv	8.8497 ii	— 2	— .5	—1.2	40 45 46.56	— 9 22.35	— 97	— 23	—16	6	22.91	
	7		13.9030	25.0160	— 53	— .3	.0	40 41 3.75	— 4 40.88	+ 7	— 5	— 8	6	22.87	27.8
	8		8.0923 ii	29.5163iv	— 14	— .4	+ .2	40 27 20.24	+ 9 1.71	+ 98	— 4	+18	8	23.15	27.6
	9		18.1470	22.1473	+ 5	+2.0	+ .4	40 34 41.62	+ 1 41.17	— 2	+ 37	+ 3	6	23.23	
Mar.	10		11.8230	28.3453	+ 11	+1.5	— .1	40 29 25.00	+ 6 57.82	— 10	+ 22	+12	6	23.12	27.6
22	II 1	R	22.4517	16.6837	— 22	+1.3	+1.9	40 38 49.03	— 2 25.80	+ 4	+ 45	— 4	6	23.74	31.3
	2		18.1573	22.6370	+ 16	+1.8	+1.3	40 38 16.78	— 1 53.32	+ 3	+ 45	— 3	6	23.97	
	3		25.7033	28.7683	+196	+ .1	— .5	40 35 4.54	+ 1 18.00	— 2	— 5	+ 3	6	22.56	31.3
	5		19.9747	20.2627	+ 2	+2.0	+1.7	40 36 14.91	+ 7.30	— 0	+ 67	0	8	22.96	31.3
	6		7.2643 ii	29.5137iv	— 31	— .4	.0	40 45 46.68	— 9 22.54	—1.01	— 6	—16	6	22.97	30.9
	7		25.5847	14.4873	+ 3	— .2	— .2	40 41 3.85	— 4 40.62	+ 7	— 5	— 8	6	23.23	30.5
	8		30.6460iv	9.2120 ii	— 1	—1.6	— .5	40 27 20.33	+ 9 1.99	+1.02	— 32	+18	8	23.28	
	9		22.6443	18.6250	+ 22	+ .4	+ .7	40 34 41.71	+ 1 41.69	— 2	+ 15	+ 3	6	23.62	
Mar.	10		29.0357	12.5127	+109	+ .9	— .3	40 29 25.08	+ 6 58.09	— 10	+ 10	+12	6	23.35	30.8
23	I 6	R	17.9890	24.6390	+ 78	+2.9	+2.1	40 33 34.04	+ 2 48.35	— 4	+ 73	+ 5	6	23.19	40.9
	7		13.6073	29.7520	+235	+1.5	+1.6	40 43 12.03	— 6 48.84	+ 10	+ 45	—13	7	23.68	39.9
	8		17.9277	24.3477	+ 65	+ .8	+1.5	40 33 40.96	+ 2 42.51	— 4	+ 32	+ 5	6	23.86	39.4
	9		18.6870	23 9640	+ 62	+1.4	+ .2	40 38 36.51	— 2 13.59	+ 3	+ 25	— 4	7	23.23	
Mar.	10		32.0287iv	10.4970 ii	+ 16	— .2	— .1	40 27 17.32	+ 9 4.51	+1.07	— 4	+19	9	23.14	39.1
25	II 1	D	17.3913	23.1977	+ 15	+1.6	+1.5	40 38 49.61	— 2 26.86	+ 4	+ 44	— 4	6	23.25	40.0
	2		21.9073	17.3787	— 14	+ .2	.0	40 38 17.35	— 1 54.48	+ 3	+ 3	— 3	6	22.96	
	3		21.0763	18.0010	— 13	.0	— .4	40 35 5.08	+ 1 17.73	— 2	— 5	+ 3	6	22.83	40.0
	4		20.4850	19.0217	— 2	— .2	+ .2	40 37 0.29	— 37.00	+ 1	0	— 1	7	23.36	39.6
	5		20.3453	20.0393	+ 2	+ .4	— .3	40 36 15.37	+ 7.74	— 0	+ 2	0	8	23.21	
	6		29.5543iv	7.3140 ii	— 30	— .7	—1.9	40 45.47.17	— 9 22.31	—1.06	— 35	—16	6	23.35	39.4
	7		15.0333	26.1467	+ 56	—1.8	— .3	40 41 4.30	— 4 41.16	+ 7	— 38	— 8	6	22.86	
	8		8.2597 ii	29.6753iv	— 12	.0	— .1	40 27 20.72	+ 9 1.50	+1.07	— 2	+18	8	23.53	39.1
	9		21.4143	25.4190	+120	— .2	— .4	40 34 42 11	+ 1 41.57	— 2	— 8	+ 3	6	23.67	
Mar.	10		12:4927	29.0053	—106	— .5	— .2	40 29 25.47	+ 6 57.28	— 10	— 10	+12	6	22.73	
28	II 1	R	23.4780	17.6397	+ 29	+ .4	+ .1	40 38 50.27	— 2 27.70	+ 4	+ 8	— 4	6	22.71	31.5
	2		17.6227	22.1960	— 5	+ .9	+1.1	40 38 18.02	— 1 55.63	+ 3	+ 28	— 3	6	22.73	
	3		19.4963	22.5150	+ 26	+2.7	+1.3	40 35 5.72	+ 1 16.40	— 2	+ 60	+ 3	6	22.79	31.2
	4		19.6317	21.1740	+ 3	— .2	+1.1	40 37 0.88	— 39.01	+ 1	+ 11	— 1	7	22.05	
	5		22.5147	22.7637	+ 6	+ .3	+ .1	40 36 15.92	+ 6.31	— 0	+ 6	0	8	22.37	31.5
	6		9.5123 ii	31.8087iv	+ 12	— .4	+1.6	40 45 47.77	— 9 23.83	—1.06	+ 14	—16	6	22.92	31.6
	7		26.2230	15.0723	+ 62	+1.1	+ .1	40 41 4.87	— 4 42.12	+ 7	+ 19	— 8	6	22.99	31.4
	8		32.2333iv	10.8677 ii	+ 18	+ .3	+ .8	40 27 21.23	+ 9 0.31	+1.07	+ 15	+18	8	23.02	
	9		22.8273	18.8560	+ 30	+ .4	+ .2	40 34 42.65	+ 1 40.65	— 2	+ 9	+ 3	6	23.46	
Apl.	10		29.0003	12.5137	+106	—1.6	— .6	40 29 26.00	+ 6 57.16	— 10	— 33	+12	6	22.91	31.1
10	II 1	D	18.3873	23.3290	+ 36	+ .9	+1.4	40 38 52.88	— 2 30.34	+ 6	+ 32	— 4	6	22.94	36.4
	2		21.2993	16.6307	— 46	+2.4	+2.5	40 38 20.65	— 1 57.94	+ 5	+ 70	— 3	6	23.49	
	3		20.4983	17.5670	— 24	+2.0	+2.4	40 35 8.29	+ 1 14.06	— 3	+ 62	+ 3	6	23.03	35.8
	4		21.0473	19.4480	+ 2	— .6	+ .6	40 37 3.23	— 0 40.45	+ 2	— 2	— 1	7	22.84	
	5		20.3713	20.2027	+ 1	+2.2	+2 4	40 36 18.13	+ 4.27	— 0	+ 66	0	8	23.14	
	6		31.2073iv	8.8193 ii	— 1	+2.7	+1.8	40 45 50.22	— 9 26.12	— 97	+ 66	—16	6	23.69	
	7		13.7890	25.0623	— 62	+2.0	+2.5	40 41 7.21	— 4 44.91	+ 12	+ 64	— 8	6	23.04	35.1
	8		8.3083 ii	29.5890iv	— 11	+1.9	+2.8	40 27 23 33	+ 8 58.09	+ 98	+ 66	+18	8	23.32	35.6
	9		14.4460	18.3273	—122	+2.1	+1.7	40 34 44.85	+ 1 37.84	— 4	+ 55	+ 3	6	23.29	
Apl.	10		12.1687	28.5800	+ 54	+ .4	—1.4	40 29 28.21	+ 6 55.12	— 17	— 11	+12	6	23.23	35.5
11	II 1	R	24.9387	19.0023	+103	+ .2	+1.8	40 38 53.12	— 2 30.37	+ 6	+ 26	— 4	6	23.09	35.9
	2		17.1537	21.7933	— 22	.0	— .5	40 38 20.89	— 1 57.26	+ 5	— 6	— 3	6	23.65	
	3		18.7727	21.7333	+ 7	— .9	— .7	40 35 8.53	+ 1 14.88	— 3	— 23	+ 3	6	23.24	35.0
	4		20.7417	22.3590	+ 23	+ .3	.0	40 37 3.46	— 40.95	+ 2	+ 5	— 1	7	22.64	

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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Apl. 11	II 5	R	21.5950	21.7847	+ 4	—1.7	—1.5	40 36 18.34	+ 4.81	— 0	— 46	0	8	40 36 22.77	
	6		9.5497 II	31.9193 IV	+ 14	—1.9	—1.3	40 45 50.45	— 9 25.69	— 97	— 47	—16	6	23.22	
	7		26.9000	15.6823	+126	— .4	— .8	40 41 7.45	— 4 43.98	— 12	— 16	8	6	23.41	35.0
	8		32.5597 IV	11.2733 II	+ 23	—1.0	— .2	40 27 23.54	+ 8 58.32	— 98	— 18	+ 18	8	22.92	
	9		22.6130	18.7257	+ 23	— .8	.0	40 34 45.07	+ 1 38.36	— 4	— 13	+ 3	6	23.35	
Apl. 14	10		30.6600	14.3023	+354	+ .5	+ .6	40 29 28.42	+ 6 54.53	— 17	— 15	+ 12	6	23.11	35.0
	II 1	D	17.9547	23.8813	+ 49	—1.2	— .6	40 38 53.77	— 2 29.99	+ 6	— 27	— 4	6	23.59	43.5
	2		22.7533	18.0990	+ 17	—1.6	—2.2	40 38 21.56	— 1 57.74	— 5	— 53	— 3	6	23.37	42.7
	3		18.6480	15.6957	— 73	—2.4	—1.1	40 35 9.20	+ 1 14.47	— 3	— 52	+ 3	6	23.21	
	4		22.4910	20.8690	+ 24	+ .7	+ .8	40 37 4.08	— 41.08	+ 2	+ 21	— 1	7	23.29	
	5		20.9853	20.8250	+ 1	— .9	— .2	40 36 18.94	+ 4.06	— 0	— 17	0	8	22.91	
	6		31.1033 IV	8.7117 II	— 4	— .7	— .7	40 45 51.12	— 9 26.20	— 97	— 20	—16	6	23.65	
	7		15.3093	26.5577	+ 91	— .6	.0	41 41 8.11	— 4 44.67	+ 12	— 9	8	6	23.45	42.6
	8		8.5440 II	29.8497 IV	— 9	—2.2	— .5	40 27 24.14	+ 8 58.73	+ 98	— 42	+ 18	8	23.69	
	9		16.9377	20.8213	— 40	+1.5	— .2	40 34 45.72	+ 1 38.10	— 4	+ 21	+ 3	6	24.08	
Apl. 15	10		11.9623	28.3213	+ 20	+ 1.3	— .3	40 29 29.09	+ 6 53.72	— 17	+ 17	+ 12	6	22.99	42.6
	II 1	R	24.5263	18.5713	+ 81	+ .4	+ .9	40 38 53.97	— 2 30.79	+ 6	+ 21	— 4	6	23.47	43.1
	2		17.1363	21.8383	— 22	+ .5	+ .8	40 38 21.75	— 1 58.84	+ 5	+ 18	— 3	6	23.17	
Apl	3		19.1570	22.0747	+ 16	+2.0	+ .2	40 35 9.40	+ 1 13.82	— 3	+ 34	+ 3	6	23.62	42.6
18	II 1	D	17.4787	23.4730	+ 27	+ .6	+1.0	40 38 54.59	— 2 31.64	+ 6	+ 22	— 4	6	23.25	44.4
	2		23.2750	18.5763	+ 39	.0	— .2	40 38 22.40	— 1 58.91	+ 5	— 2	— 3	6	23.55	44.3
	3		22.1453	19.2530	+ 17	+1.2	+ .3	40 35 10 04	+ 1 13.18	— 3	+ 23	+ 3	6	23.51	
	4		20.7513	22.4147	+ 23	—2.0	— .6	40 37 4.83	— 42.12	+ 2	— 39	— 1	7	22.40	44.6
	5		20 8557	21.0330	+ 1	—2.4	—2.3	40 36 19.66	+ 4.49	— 0	— 68	0	8	23.55	
	6		8.2493 II	30.6890 IV	— 11	— .2	+2.5	40 45 51.93	— 9 27.40	— 97	+ 29	+ 16	6	23.75	
	7		26.2590	14.9513	+ 60	+ .9	+ .8	40 41 8.91	— 4 46.09	+ 12	+ 24	— 8	6	23.16	42.9
	8		33.6620 IV	12.4170 II	+ 34	+ 1.1	— .7	40 27 24.85	+ 8 57.30	+ 98	+ 8	+ 18	8	23.47	
	9		22.4220	18.5810	+ 17	—1.9	— .6	40 34 46.48	+ 1 37.17	— 4	— 38	+ 3	6	23.32	
Apl. 19	10		29.2090	12.8933	+149	—1.0	— .9	40 29 29.87	+ 6 52.95	— 17	— 27	+ 12	6	22.56	42.1
	II 1	R	22.9717	16.9717	— 2	+ .8	+ .3	40 38 54.83	— 2 31.72	+ 6	+ 17	— 4	6	23.36	55.6
	2		18.0680	22.8080	+ 19	— .2	+ .9	40 38 22.63	— 1 59.91	+ 5	+ 8	— 3	6	22.88	
	3		18.5833	21.4753	0	+ .4	+3.1	40 35 10.27	+ 1 13.13	— 3	+ 46	+ 3	6	23.92	54.4c
	4		20.9577	19.2967	+ 1	— .6	+ .6	40 37 5.06	— 42.00	+ 2	— 2	— 1	7	23.12	
	5		20.3087	20.1617	— 0	— .8	— .7	40 36 19.87	+ 3.72	— 0	— 22	0	8	23.45	53.4
	6		30.3723 IV	7.9133 II	— 17	+ .3	— .3	40 45 52.16	— 9 27.87	— 97	+ 1	—16	6	23.23	
	7		15.1640	26.4753	+ 81	— .2	.0	40 41 9.13	— 4 46.23	+ 12	— 3	— 8	6	22.97	53.3
	8		8.1767 II	29.4340 IV	— 12	— .7	.0	40 27 25.05	+ 8 57.50	+ 98	— 11	+ 18	8	23.68	53.0
	9	D	17.0670	20.9057	— 33	+ .1	— .6	40 34 46.69	+ 1 36.98	— 4	— 6	+ 3	6	23.66	
Apl. 20	10		12.3223	28.6427	+ 68	+1.0	— .2	40 29 30.08	+ 6 52.86	— 17	+ 13	+ 12	6	23.08	
	II 1	D	16.7740	22.7653	— 13	—2.0	—1.9	40 38 55.08	— 2 31.47	+ 6	— 56	— 4	6	23.13	45.2
	2	D	22.5360	17.8183	+ 8	—2.0	—2.5	40 38 22.89	— 1 59.32	+ 5	— 64	— 3	6	23.01	
	3	D	21.3860	18.4987	— 2	— .2	— .3	40 35 10.52	+ 1 13.01	— 3	— 7	+ 3	6	23.52	46.2
	4	R	19.6467	21.3227	+ 5	— .2	+ .2	40 37 5.29	— 42.39	+ 2	— 0	— 1	7	22.98	45.1
	5		21.4690	21.6057	+ 1	— .4	— .8	40 36 20.09	+ 3.46	— 0	— 16	0	8	23.47	
	6		8.5290 II	30.9840 IV	— 6	—1.9	.0	40 45 52.41	— 9 27.80	— 97	— 30	—16	6	23.24	
	7		25.8120	14.4667	+ 12	+ .3	.0	40 41 9.38	— 4 46.92	+ 12	+ 5	— 8	6	22.61	44.4
	8		32.5640 IV	11.3090 II	+ 23	—1.1	— .7	40 27 25.27	+ 8 57.53	+ 98	— 26	+ 18	8	23.78	45.4
	9		24.5520	20.7273	+ 89	—1.6	— .9	40 34 46.92	+ 1 36.94	— 4	— 37	+ 3	6	23.54	
Apl. 21	10		28.4423	12.1330	+ 41	+ 3	— .4	40 29 30.32	+ 6 52.51	— 17	0	+ 12	6	22.84	44.9
	II 1	R	23.8867	17.8707	+ 47	— .6	+ .2	40 38 55.35	— 2 32.24	+ 6	— 7	— 4	6	23.12	47.3
	2	R	18.1757	22.8960	+ 22	—1.7	— .9	40 38 23.16	— 1 59.42	+ 5	— 39	— 3	6	23.43	
	3	R	19.0743	21.9520	+ 13	—1.0	— .8	40 35 10.79	+ 1 12.80	— 3	— 26	+ 3	6	23.39	47.8
	4	D	21.7153	20.0293	+ 12	— .2	+ .4	40 37 5.54	— 42.66	+ 2	+ 2	— 1	7	22.98	47.4
	5		24.5763	24.4523	+ 4	—1.2	—1.4	40 36 20.34	+ 3.15	— 0	— 37	0	8	23.20	
	6		31.0857 IV	8.6297 II	— 5	+ .4	— .2	40 45 52.68	— 9 27.83	— 97	+ 4	—16	6	23.82	

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Apl.								° ′ ″						° ′ ″	°
21	II 7	D	13.8827	26.2357	— 43	—2.3	—1.2	40 41 9.63	— 4 46.97	+ 12	— 52	— 8	6	40 36 22.24	47.4
	8		9.2260 ii	30.4457 iv	— 1	+ .4	+ .1	40 27 25.51	+ 8 56.57	+ 98	+ 8	+18	8	23.40	
	9		18.1303	21.9447	+ 1	—1.0	— .9	40 34 47.18	+ 1 36.46	— 4	— 27	+ 3	6	23.42	46.6
Apl.	10		12.5253	28.8113	+ 93	+1.1	+ .4	40 29 30.57	+ 6 52.06	— 17	+ 22	+12	6	22.86	
23	II 1	D	17.1100	23.1430	+ 6	—1.0	—1.2	40 38 55.90	— 2 32.57	+ 6	— 31	— 4	6	23.10	47.3
	2	D	21.8953	17.1347	— 21	— .2	—1.4	40 38 23.73	— 2 0.33	+ 5	— 21	— 5	6	23.25	
	3	D	22.5500	19.7070	+ 28	+ .2	— .2	40 35 11.36	+ 1 11.96	— 3	0	+ 2	6	23.37	46.1
	4	R	18.3003	20.0163	— 13	—2.0	— .1	40 37 6.08	— 43.36	+ 2	— 33	— 2	7	22.46	
	5		21.3387	21.4420	+ 2	—1.2	—1.9	40 36 20.85	+ 2.62	— 0	— 44	0	8	23.11	45.4
	6		9.1953 ii	31.6677 iv	+ 9	+ .4	— .8	40 45 53.24	— 9 28.28	—1.05	— 3	—17	6	23.77	
	7		25.5317	14.1977	— 13	— .8	— .8	40 41 10.18	— 4 46.57	+ 12	— 23	— 9	6	23.47	45.7
	8		31.4723 iv	10.2647 ii	+ 8	— .1	+ .6	40 27 26.02	+ 8 56.29	+1.06	+ 6	+18	8	23.69	
	9		23.5970	20.7940	+ 55	— .1	— .2	40 34 47.72	+ 1 36.30	— 4	— 4	+ 3	6	24.03	
May	10		27.4743	11.1867	— 95	— .3	.0	40 29 31.13	+ 6 51.62	— 17	— 5	+12	6	22.71	45.6
1	II 1	R	23.7223	17.5903	+ 36	+2.7	+2.5	40 38 57.69	— 2 35.15	+ 6	+ 75	— 4	6	23.37	
	2	R	17.9663	22.8263	+ 18	—1.0	— .2	40 38 25.57	— 2 2.94	+ 5	— 18	— 3	6	22.53	
	3	R	17.7720	20.5350	— 19	—1.1	—1.0	40 35 13.25	+ 1 9.82	— 3	— 30	+ 3	6	22.83	47.4
	4	D	21.9757	20.1610	+ 17	+1.2	+ .7	40 37 7.85	— 45.93	+ 2	+ 28	— 2	7	22.27	47.5
	5		21.7280	21.7187	0	+1.4	— .3	40 36 22.56	+ 0.24	— 0	+ 18	0	8	23.06	
	6		32.1960 iv	9.6530 ii	+ 19	— .4	—1.5	40 45 55.17	— 9 30.09	—1.05	— 25	—17	6	23.67	47.2
	7		15.8513	27.2973	+157	+2.7	+1.7	40 41 12.13	— 4 49.83	+ 12	+ 65	— 9	6	23.04	46.1
	8		9.7507 ii	30.8627 iv	+ 2	+ .7	+ .5	40 27 27.80	+ 8 53.86	+1.06	+ 17	+18	8	23.15	
	9		19.8513	23.5603	+ 58	— .4	— .8	40 34 49.63	+ 1 33.94	— 4	— 17	+ 3	6	23.45	
May	10		13.1827	29.3587	+180	+1.2	— .3	40 29 33.10	+ 6 49.49	— 17	+ 16	+12	6	22.76	
3	II 1	D	18.0827	24.2100	+ 62	+1.7	+ .4	40 38 58.16	— 2 35.10	+ 6	+ 32	— 4	6	23.46	
	2	D	23.2250	18.3437	+ 33	+1.1	+1.2	40 38 26.04	— 2 3.52	+ 5	+ 33	— 3	6	22.93	
	3	D	21.9130	19.1710	+ 13	—1.1	— .9	40 35 13.72	+ 1 9.37	— 3	— 28	+ 2	6	22.86	62.6
	4	R	18.4170	20.2183	— 11	+1.7	+ .5	40 37 8.29	— 45.52	+ 2	+ 34	— 2	7	23.18	
	5		22.4593	22.4613	0	+ .2	— .3	40 36 22.98	+ .05	— 0	0	0	8	23.11	
	6		8.5070 ii	31.0853 iv	— 6	— .9	—1.3	40 45 55.64	— 9 30.92	—1.05	— 31	—17	6	23.25	
	7		28.1683	16.7253	+241	+ .5	—1.6	40 41 12.61	— 4 49.97	+ 12	— 12	— 9	6	22.61	62.0
	8		32.6077 iv	11.5147 ii	+ 21	+ .9	+1.5	40 27 28.23	+ 8 53.43	+1.06	+ 33	+18	8	23.31	
May	9		24.8893	21.2267	+100	+1.0	+1.3	40 34 50.10	+ 1 32.87	— 4	+ 32	+ 3	6	23.34	*d*
6	II 1	R	24.3623	18.2123	+ 70	+1.4	+ .7	40 38 58.95	— 2 35.69	+ 6	+ 31	— 4	6	23.65	65.6
	2	R	18.2103	23.0987	+ 28	— .1	—1.3	40 38 26.85	— 2 3.68	+ 5	— 18	— 3	6	23.07	
	3	R	19.2073	21.9197	+ 13	+ .2	— .1	40 35 14.55	+ 1 8.62	— 3	+ 1	+ 3	6	23.24	65.6
	4	D	22.5233	20.6877	+ 25	.0	+ .4	40 37 9.06	— 46.48	+ 2	+ 5	— 2	7	22.70	
	5		20.4747	20.6027	0	—1.4	—1.4	40 36 23.73	— 0.71	0	— 40	0	8	22.70	
	6		31.8683 iv	9.2487 ii	+ 13	+1.3	+ .3	40 45 56.48	— 9 32.01	—1.05	+ 25	—17	6	23.56	
	7		14.6423	26.1460	+ 39	—1.0	— .1	40 41 13.44	— 4 50.99	+ 12	— 17	— 9	6	22.37	64.8
	8		11.5660 ii	32.6453 iv	+ 21	+ .1	+ .9	40 27 28.99	+ 8 53.08	+1.06	+ 13	+18	8	23.52	
	9		17.3793	21.0390	— 26	+ .4	+ .9	40 34 50.93	+ 1 32.48	— 4	+ 18	+ 3	6	23.64	
May	10		13.4987	29.6330	+220	+ .9	.0	40 29 34.41	+ 6 48.54	— 17	+ 14	+12	6	23.10	63.5
9	II 1	D	17.8607	24.0670	+ 53	+ .4	+ .1	40 38 59.73	— 2 37.07	+ 9	+ 8	— 4	6	22.85	70.0
	2	D	24.6453	19.7220	+ 94	+ .9	+ .3	40 38 27.66	— 2 4.73	+ 7	+ 18	— 3	6	23.21	
	3	D	22.1153	19.4380	+ 17	— .8	— .3	40 35 15.38	+ 1 7.74	— 3	— 17	+ 3	6	23.01	69.9
	4	R	18.2320	20.0937	— 14	—1.7	—1.4	40 37 9.85	— 47.04	+ 3	— 45	— 2	7	22.44	
	5		21.5647	21.4967	+ 1	— .9	— .9	40 36 24.51	— 1.72	— 0	— 26	0	8	22.61	
	6		9.0933 ii	31.7577 iv	+ 9	+ 1	— .1	40 45 57.34	— 9 33.13	— 97	0	—17	6	23.13	
	7		26.3013	14.7713	+ 55	— .4	— .7	40 41 14.33	— 4 51.69	+ 16	— 15	— 9	6	22.62	68.6
	8		31.7463 iv	10.6903 ii	+ 10	.0	— .5	40 27 29.81	+ 8 52.46	+1.00	— 6	+18	8	23.47	
	9		21.8370	18.1977	0	—1.6	— .5	40 34 51.80	+ 1 32.03	— 5	— 32	+ 3	6	23.55	
	10		28.6897	12.5827	+ 91	+1.1	+ .1	40 29 35.32	+ 6 47.52	— 21	+ 19	+12	6	23.00	68.4
	III 1	R	29.8550 iv	14.2747 ii	— 82	— .9	— .3	40 42 58.10	— 6 33.77	—1.07	— 18	—14	9	23.03	67.6
	2		6.8433 ii	31.0547 iv	— 41	+1.1	+1.1	40 46 36.44	—10 12.12	— 95	+ 31	—24	11	23.55	

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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May 9	III 3	R	8.8813 II	34.2007 IV	+ 73	+2.1	+1.7	40 25 40.63	+10 40.44	+ 94	+ 55	+ 18	5	40 36 22.79	66.4
	4		9.4077 II	34.4990 IV	+ 88	+1.8	+ .9	40 25 47.13	+10 34.70	+ 95	+ 40	+ 19	6	23.43	65.4
	5		26.6343	14.9430	+ 82	+ .2	+ .3	40 31 26.78	+ 4 55.84	— 15	+ 6	+ 10	7	22.70	
	6		18.3283	21.8740	+ 2	+3.0	+2.7	40 37 51.90	— 1 29.66	+ 5	+ 82	— 3	6	23.14	
	7		18.1500	16.6290	— 36	+ .1	—1.1	40 37 1.17	— 38.37	+ 2	- 12	— 1	6	22.75	
	8		15.2193	21.9240	— 85	+ .3	+ .5	40 33 33.17	+ 2 49.33	— 9	+ 11	+ 4	6	22.62	65.5
May 9			12.4907	26.2783	— 73	—1.2	— .1	40 42 11.31	— 5 48.46	+ 19	— 21	—10	5	22.78	
10	III 1	D	10.5550	26.2287	—220	+1.2	+1.2	40 42 58.36	— 6 35.78	+ 21	+ 35	—14	9	23.09	70.4
	2		34.2160 IV	10.0163 II	+ 78	— .3	— .7	40 46 36.69	—10 12.13	— 95	— 14	—24	11	23.34	69.9
	3		31.4463 IV	6.1153 II	— 59	— .7	—1.0	40 25 41.32	+10 40.39	+ 94	— 24	+ 18	5	22.64	
	4		32.8750 IV	7.7513 II	+ 15	—1.5	— .8	40 25 47.40	+10 35.33	+ 95	— 34	+19	6	23.59	
	5		15.0630	26.7647	+ 93	— .8	— .2	40 31 27.04	+ 4 56.13	— 15	— 15	+ 10	7	23.01	68.9
	6		22.9010	19.3640	+ 35	— .2	— .1	40 37 52.16	— 1 29.53	+ 5	— 4	— 3	6	22.67	68.6
	7		19.5390	21.0753	+ 2	+ .2	— .2	40 37 1.43	— 38.85	+ 2	0	— 1	6	22.65	68.7
	8		24.0813	17.4020	+ 44	+ .3	— .2	40 33 33.43	+ 2 49.01	— 9	+ 2	+ 4	6	22.47	68.3
May 12	II 1	R	29.8930	16.1550	+360	+ .3	— .3	40 42 11.56	— 5 48.30	+ 19	+ 1	—10	5	23.41	
			23.8617	17.6380	+ 41	— .7	— .3	40 39 0.37	— 2 37.48	+ 9	— 14	— 4	6	22.86	45.5
May 13	2		17.0733	22.0533	— 20	+1.5	+1.2	40 38 28.34	— 2 5.88	+ 7	+ 39	— 3	6	22.95	44.7
	II 1	D	18.2217	24.4367	+ 74	— .8	— .8	40 39 0.58	— 2 37.34	+ 9	— 23	— 4	6	23.12	49.2
	2		22.7573	17.7883	+ 12	+2.3	+ .3	40 38 27.66	— 2 5.68	+ 7	+ 40	— 3	6	22.48	
	3		21.2760	18.6367	— 3	— .8	— .4	40 35 16.30	+ 1 6.73	— 3	— 18	+ 3	6	22.91	48.6
	4		21.1457	19.2220	+ 1	+1.0	+ 1.4	40 37 10.72	— 48.65	+ 3	+ 34	— 2	7	22.49	
	5		20.3793	20.4773	0	.0	+ 1.4	40 36 25.36	— 2.48	— 0	+ 18	0	8	23.14	
	6		31.6107 IV	8.9127 II	+ 5	+ 1.7	+ .8	40 45 58.32	— 9 33.97	— 97	+ 37	—17	6	23.64	
	7		15.7333	27.2700	+150	—1.0	+ .2	40 41 15.33	— 4 52.10	+ 16	— 13	— 9	6	23.23	47.0
	8		9.4760 II	30.4667 IV	— 0	+ .9	+ 1.4	40 27 30.74	+ 8 50.79	+1.00	+ 32	+ 18	8	23.11	
May 16	9		18.6693	22.2270	+ 13	+ 1.4	+ 1.7	40 34 52.82	+ 1 30.00	— 5	+ 44	+ 3	6	23.30	46.1
	II 1	R	24.0850	17.8487	+ 53	+ 1.3	+ 1.1	40 39 1.23	— 2 37.83	+ 9	+ 35	— 4	6	23.86	46.9
	2		18.6013	21.7490	+ 8	+ 1.4	+ 2.2	40 38 29.22	— 2 7.66	+ 7	+ 50	— 3	6	22.16	
	3		19.3680	21.9870	+ 15	+ .5	— .4	40 35 16.99	+ 1 6.26	— 3	+ 3	+ 3	6	23.34	
	4		19.4157	21.3477	+ 5	—1.5	.0	40 37 11.36	— 0 48.87	+ 3	— 24	— 2	7	22.33	46.6
	5		21.2933	21.2007	0	—3.7	—3.7	40 36 25.98	— 2.34	— 0	—1.02	— 0	8	22.70	
	6		8.9763 II	31.7003 IV	+ 8	+ .2	+ .3	40 45 59.04	— 9 34.64	— 97	+ 6	—17	6	23.38	
	7		27.4067	15.8260	+162	— .1	.0	40 41 16.05	— 4 53.25	+ 16	— 1	— 9	6	22.92	45.8
	8		30.2430 IV	9.2462 II	— 2	— .2	— .6	40 27 31.40	+ 8 50.94	+1.00	— 10	+ 18	8	23.50	
	9		23.7667	20.2223	+ 62	— .5	— .2	40 34 53.55	+ 1 29.78	— 5	— 10	+ 3	6	23.27	
	10		29.4787	13.4423	+203	—1.9	—1.6	40 29 37.12	+ 6 46.02	— 21	— 51	+ 12	6	22.60	44.8
	III 1	R	30.2933	14.6540	+338	—1.2	— .6	40 42 59.69	— 6 36.32	+ 21	— 27	—14	9	23.26	41.3
	2		11.0693 II	35.3107 IV	+119	+ .4	— .3	40 46 37.97	—10 13.29	— 95	+ 2	—24	11	23.62	
	3		8.3527 II	33.6310 IV	+ 45	+ .7	— .2	40 25 42.79	+10 39.32	+ 94	+ 8	+ 18	5	23.36	
	5		27.2093	15.5683	+136	+ .7	— .4	40 31 28.37	+ 4 54.71	— 15	+ 6	+ 10	7	23.16	40.0
	6		19.3260	22.8913	+ 34	—2.3	—1.4	40 37 53.53	— 1 30.24	+ 5	— 55	— 3	6	22.82	*d*
	7		21.2880	19.6697	+ 4	+ .7	— .2	40 37 2.77	— 40.93	+ 2	+ 8	— 1	6	21.99	
	8		17.2320	23.8687	+ 32	— .4	— .5	40 33 34.74	+ 2 47.90	— 9	— 13	+ 4	6	22.52	
	9		14.0570	27.8740	+116	—1.4	+ .9	40 42 12.82	— 5 49.68	+ 19	— 11	—10	5	23.17	39.9
May 18	II 1	D	18.2890	24.5590	+ 79	— .3	.0	40 39 1.73	— 2 38.75	+ 9	— 5	— 4	6	23.04	52.0
	2		21.8227	16.8053	— 32	+ 1.9	— .0	40 38 29.73	— 2 6.79	+ 7	+ 30	— 3	6	23.34	
	3		21.1150	18.5097	— 6	—1.3	— .8	40 35 17.53	+ 1 5.86	— 3	— 31	+ 3	6	23.14	
	4		21.6063	19.6777	+ 9	— .9	—1.5	40 37 11.86	— 48.79	+ 3	— 33	— 2	7	22.82	
	5		19.6657	19.8327	0	+ 2.1	+1.0	40 36 26.48	— 4.22	— 0	+ 46	— 0	8	22,80	
	6		31.5723 IV	8.8167 II	+ 11	+ 1.6	+ .3	40 45 59.58	— 9 35.44	— 97	+ 29	—17	6	23.35	52.4
	7		14.5333	26.1503	+ 32	—2.2	— .2	40 41 16.61	— 4 53.84	+ 16	— 38	— 9	6	22.52	51.6
	8		9.5340 II	30.5093 IV	0	— .2	.0	40 27 31.91	+ 8 50.40	+1.00	— 3	+ 18	8	23.54	
	9		17.6677	21.2073	— 19	— .2	— .1	40 34 54.10	+ 1 29.46	— 5	— 5	+ 3	6	23.55	51.1
	10		13.1960	29.1993	+167	— .1	+ .9	40 29 37.68	+ 6 45.09	— 21	+ 10	+ 12	6	22.84	50.7

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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May 18	III 1	D	12.2160	27.9227	+ 7	— .7	—2.0	40 43 0.16	— 6 37.19	+ 21	— 36	—14	9	40 36 22.77	48.6
	2		33.4257iv	9.1643 ii	+ 49	— .1	+ .9	40 46 38.40	—10 13.62	— 95	+ 10	—24	11	23.80	
	3		31.6787iv	6.4143 ii	— 47	— .3	—1.0	40 25 43.30	+10 38.74	+ 94	— 18	+18	5	23.03	
	4		32.9903iv	7.9407 ii	+ 21	—1.8	—1.6	40 25 49.32	+10 33.48	+ 95	— 49	+19	6	23.51	
	5		13.7330	25.3873	— 44	— .5	— .3	40 31 28.83	+ 4 54.59	— 15	— 12	+10	7	23.32	48.4
May 22	6		21.5687	17.9733	— 7	— .3	— .8	40 37 53.99	— 1 30.90	+ 5	— 15	— 3	6	23.02	
	II 1	R	23.2150	16.8917	+ 2	+ .9	+ .2	40 39 2.74	— 2 39.90	+ 9	+ 17	— 4	6	23.12	49.6
	2		17.1100	23.1577	+ 7	—1.2	—1.1	40 38 30.78	— 2 7.66	+ 7	— 33	— 3	6	22.89	
	3		17.7933	20.3290	— 18	+1.9	+1.9	40 35 17.53	+ 1 4.07	— 3	+ 55	+ 3	6	22.21	49.8
	4		19.2163	21.2077	— 2	—1.0	— .2	40 37 12.90	— 50.35	+ 3	— 18	— 2	7	22.45	
	5		20.9503	20.7730	+ 1	—1.1	— .8	40 36 27.50	— 4.49	— 0	— 27	0	8	22.82	
	6		8.4027 ii	31.2087iv	— 7	— .7	—1.2	40 46 0.74	— 9 36.67	— 97	— 27	—17	6	22.72	49.9
	7		26.0510	14.3677	+ 20	+1.6	+1.7	40 41 17.79	— 4 55.48	+ 16	+ 48	— 9	6	22.92	
	8		31.6563iv	10.7547 ii	+ 8	— .6	+ .1	40 27 33.01	+ 8 48.55	+1.00	— 8	+18	8	22.74	49.9
	9		23.3850	19.9000	+ 52	— .6	— .3	40 34 55.29	+ 1 28.26	— 5	— 13	+ 3	6	23.46	
	10		28.1230	12.1563	+ 18	— .4	— .7	40 29 38.91	+ 6 43.79	— 21	— 11	+12	6	22.56	49.9
	III 1	R	31.3573	15.6577	+478	+ .2	— .2	40 43 1.28	— 6 38.20	+ 21	0	—14	9	23.24	47.4
	2		9.6063 ii	33.9210iv	+ 65	— .2	— .1	40 46 39.49	—10 15.00	— 95	— 4	—24	11	23.37	47.2
	3		8.4193 ii	33.5987iv	+ 46	+3.3	+1.6	40 25 44.51	+10 36.82	+ 94	+ 73	+18	5	23.23	
	4		8.6187 ii	33.6077iv	+ 49	+ .7	.0	40 25 50.51	+10 32.01	+ 95	+ 11	+19	6	23.83	
	5		25.4130	13.8250	— 39	+ .9	+ .3	40 31 29.94	+ 4 52.92	— 15	+ 18	+10	7	23.06	47.2
	6		18.6003	22.2450	+ 13	—1.4	— .3	40 37 55.13	— 1 32.20	+ 5	— 26	— 3	6	22.75	
	7		20.2147	18.5660	— 8	— .2	— .5	40 37 4.33	— 41.67	+ 2	— 9	— 1	6	22.64	
	8		18.3367	24.9090	+ 92	+ .9	— .2	40 33 36.77	+ 2 46.42	— 9	+ 12	+ 4	6	23.32	46.6
	9		18.4037	27.2883	+ 42	—1.9	+ .2	40 42 14.29	— 5 51.20	+ 19	— 28	—10	5	22.95	46.6
May 23	II 1	D	16.5467	22.8897	— 16	—1.2	— .2	40 39 2.96	— 2 40.35	+ 9	— 22	— 4	6	22.50	61.6
	2		22.9833	17.9160	+ 20	+ .9	+1.8	40 38 31.02	— 2 8.19	+ 7	+ 37	— 3	6	23.30	
	3		22.4753	19.9267	+ 28	—1.4	— .9	40 35 18.87	+ 1 4.52	— 3	— 34	+ 3	6	23.11	60.1
	4		21.5437	19.5367	+ 7	— .1	+1.6	40 37 13.14	— 50.77	+ 3	+ 19	— 2	7	22.64	
	5		19.4723	19.6840	— 1	+ .5	—1.2	40 36 27.75	— 5.35	— 0	— 7	0	8	22.41	
	6		32.0083iv	9.1977 ii	+ 14	+ .2	— .6	40 46 1.00	— 9 36.84	— 97	— 4	—17	6	23.04	
	7		14.7007	26.3997	+ 57	+ .4	+1.4	40 41 18.07	— 4 55.97	+ 16	+ 24	— 9	6	22.47	58.6
	8		9.2497 ii	30.1407iv	— 3	+ .8	+1.9	40 27 33.27	+ 8 48.26	+1.00	+ 37	+18	8	23.16	
	9		18.2990	21.7450	— 0	+ .6	+ .8	40 34 55.57	+ 1 27.14	— 5	+ 19	+ 3	6	22.94	
	10		12.2617	28.2170	+ 31	+ .1	.0	40 29 39.21	+ 6 43.54	— 21	+ 1	+12	6	22.73	58.4
	III 1	D	12.3080	28.0753	+ 25	— .2	+ .4	40 43 1.57	— 6 38.77	+ 21	+ 2	—14	9	22.98	55.6
	2		33.5757iv	9.2460 ii	+ 55	+ .9	— .1	40 46 39.78	—10 15.36	— 95	+ 13	—24	11	23.47	56.3
	3		32.3437iv	7.1487 ii	— 12	—2.5	— .9	40 25 44.84	+10 37.07	+ 94	— 51	+18	5	22.57	56.3
	4		32.9980iv	8.0103 ii	+ 22	—1.9	—1.9	40 25 50.83	+10 31.91	+ 95	— 55	+19	6	23.39	55.6
	5		13.1740	24.7773	—103	— .6	—1.7	40 31 30.25	+ 4 53.15	— 15	— 32	+10	7	23.10	
	6		22.4090	18.7537	+ 19	+ .7	+ .1	40 37 55.44	— 1 32.48	+ 5	+ 12	— 3	6	23.16	
	7		19.4870	21.1140	+ 2	—1.2	—1.2	40 37 4.64	— 41.15	+ 2	— 35	— 1	6	23.21	
	8		23.8427	17.2587	+ 32	— .5	— .9	40 33 37.07	+ 2 46.57	— 9	— 19	+ 4	6	23.46	
May 28	9		27.5213	13.6410	+ 69	—1.6	— .2	40 42 14.59	— 5 51.16	+ 19	— 28	—10	5	23.29	54.4
	II 1	R	25.4357	19.0917	+124	—1.1	—1.0	40 39 3.88	— 2 40.73	+ 9	— 30	— 4	6	22.96	61.8
	2		17.5180	22.6170	+ 2	+ .3	+ .6	40 38 31.99	— 2 8.94	+ 7	+ 12	— 3	6	23.27	
	3		19.4987	21.9843	+ 15	+1.6	+2.1	40 35 19.91	+ 1 2.89	— 3	+ 52	+ 3	6	23.38	61.1
	4		20.9440	22.9743	+ 41	+1.0	+4.0	40 37 14.12	— 51.43	+ 3	+ 21	— 2	7	22.98	60.6
	5		21.8063	21.5793	+ 4	— .7	—1.7	40 36 28.71	— 5.75	— 0	— 33	— 0	8	22.71	
	6		9.0747 ii	31.9210iv	+ 12	+ .1	+ .3	40 46 2.14	— 9 37.74	— 97	+ 5	—17	6	23.37	60.4
	7		26.3330	14.6303	+ 47	— .0	— .4	40 41 19.26	— 4 56.04	+ 16	— 5	— 9	6	23.30	60.0
	8		31.1387iv	10.2653 ii	+ 3	— .1	— .1	40 27 34.37	+ 8 47.83	+1.00	— 3	+18	8	23.43	
	9		22.6723	19.2440	+ 28	+ .7	+1.8	40 34 56.81	+ 1 26.76	— 5	+ 34	+ 3	6	23.95	
	10		30.3203	14.4373	+329	— .1	+ .2	40 29 40.48	+ 6 42.46	— 21	+ 1	+12	6	22.92	59.0
	III 1	R	28.7387	12.9400	+117	— .4	+ .4	40 43 2.83	— 6 39.79	+ 21	— 1	—14	9	23.19	57.4

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
May								° ′ ″						° ′ ″	°
28	III 2	R	7.9107 ii	32.2887 iv	+ 4	.0	— .7	40 46 41.02	— 10 16.45	— 95	— 9	— 24	11	10 36 23.40	
	3		7.1950 ii	32.3230 iv	— 12	+ 1.5	+ .4	40 25 46.27	+ 10 35.38	+ 94	+ 29	+ 18	5	23.11	
	4		6.4070 ii	31.3303 iv	— 51	— .2	— .2	40 25 52.24	+ 10 30.10	+ 95	— 5	+ 19	6	23.49	
	5		27.2697	15.7700	+ 151	— .6	.0	40 31 31.59	+ 4 51.17	— 15	— 9	+ 10	7	22.69	57 3
	6		19.1537	22.8610	+ 33	—1.5	.0	40 37 56.85	— 1 33.83	+ 5	— 24	— 3	6	22.86	
	7		21.9400	20.2223	+ 15	+ .3	— .5	40 37 6.01	— 43.47	+ 2	— 1	- 1	6	22.63	55.8
	8		18.4503	21.9193	- 95	— .4	+ .4	40 33 38.47	+ 2 43.82	- 9	— 1	+ 4	6	22.29	
May	9		15.2607	29.2067	+ 270	+ 1.2	+ .8	40 42 15.95	— 5 53.33	+ 19	+ 29	—10	5	23.05	55.8
29	II 1	D	15.3167	21.7423	— 82	— .1	+ .4	40 39 4.05	— 2 41.52	+ 9	+ 3	- 4	6	22.67	70.9
	2		23.5237	18.4167	+ 43	+ .4	+ .8	40 38 32.18	— 2 9.25	+ 7	+ 16	- 3	6	23.19	
	3		21.4317	18.9620	+ 4	+ .2	+ .5	40 35 20.11	+ 1 2.46	- 3	+ 9	+ 3	6	22.72	69.9
	4		21.4357	19.3727	+ 6	+ .7	+ 2.3	40 37 14.31	— 52.18	+ 3	+ 40	— 2	7	22.61	69.4
	5		21.3003	21.5577	- 4	— .4	— .1	10 36 28.89	— 6.52	- 0	- 8	0	8	22.37	
	6		33.6670 iv	10.7977 ii	+ 57	+ 1.7	+ 1.0	40 46 2.35	— 9 38.43	— 97	+ 40	— 17	6	23.21	
	7		15.6523	27.3723	+ 155	— .6	+ .5	40 41 19.48	— 4 56.75	+ 16	— 3	- 9	6	22.83	69.4
	8		7.8933 ii	28.7387 iv	- 12	— .4	+ .4	40 27 34.57	+ 8 47.08	+ 1.00	— 1	+ 18	8	22.90	
	9		18.7373	22.1527	+ 13	+ .3	+ .3	40 34 57.02	+ 1 26.40	— 5	+ 9	- 3	6	23.55	
	10		13.4973	29.4017	+ 201	— .6	—1.5	10 29 40.72	+ 6 42.75	- 21	- 28	+ 12	6	23.16	69.3
	III 1	D	11.6770	27.4983	- 58	.0	+ 1.4	40 43 3.06	— 6 39.92	+ 21	+ 18	—14	9	23.48	70.1
	2		32.9617 iv	8.5630 ii	+ 30	+ .9	.8	40 46 41.24	—10 17.04	- 95	+ 43	—24	11	23.55	
	3		31.4820 iv	9.3677 ii	+ 88	—1.0	.7	40 25 46.51	+ 10 35.28	+ 94	— 25	+ 18	5	22.74	70.3
	4		32.2850 iv	7.3647 ii	— 8	— .8	.1	40 25 52.49	+ 10 30.13	+ 95	— 14	+ 19	6	23.68	
	5		12.6780	24.2077	- 157	+ .8	+ .7	40 31 31.81	+ 4 51.15	— 15	+ 22	+ 10	7	23.23	68.4
	6		21.6370	17.9033	- 9	+ .5	+ .3	40 37 57.11	— 1 34.39	+ 5	+ 12	— 3	6	22.92	68.3
	7		19.4893	21.2083	+ 3	— .2	— .7	40 37 6.29	- 43.48	+ 2	- 12	— 1	6	22.76	
	8		23.3887	16.8920	+ 9	— .8	- .2	40 33 38.72	+ 2 44.30	- 9	— 15	+ 4	6	22.88	68.4
May	9		27.1227	13.1613	+ 17	+ .3	+ .1	40 42 16.20	+ 5 53.08	+ 19	+ 6	- 10	5	23.32	68.4
30	II 1	R	21.1530	17.8063	+ 55	—1.1	—1.0	40 39 4.25	— 2 40.63	+ 9	— 30	+ 4	6	23.43	80.0
	2		19.1713	21.2953	+ 79	+ 1.2	+ .7	40 38 32.38	— 2 9.77	+ 7	+ 28	— 3	6	22.99	
	3		17.7260	20.2033	— 22	- .7	+ .5	40 35 20.32	+ 1 2.59	- 3	+ 17	+ 3	6	23.14	79.2
	4		20.1123	22.1670	+ 20	+ .5	.0	40 37 14.51	- 52.01	+ 3	+ 8	- 2	7	22.66	78.6
	5		20.9113	20.6163	+ 2	- .2	— .6	40 36 29.09	- 6.71	- 0	- 10	0	8	22.36	
	6		9.4743 ii	32.3143 iv	- 22	+ .3	— .1	40 46 2.58	— 9 38.36	— 97	+ 3	—17	6	23.17	77.4
	7		25.9797	11.2317	- 11	+ 1.0	+ 1.1	40 41 19.72	— 4 57.10	+ 16	+ 30	— 9	6	23.05	
	8		31.6163 iv	10.7833 ii	+ 7	+ .7	+ .3	40 27 34.78	+ 8 46.82	+ 1.00	+ 15	+ 18	8	23.01	77.6
	9		23.2053	19.8020	+ 44	+ .7	+ .2	40 31 57.26	+ 1 26.17	- 5	+ 13	+ 3	6	23.60	
	10		30.1153	11.2613	+ 300	+ 1.0	+ .6	40 29 40.97	+ 6 41.65	— 21	+ 23	+ 12	6	22.82	77.4
	III 1	R	27.5983	11.7813	— 43	— .4	+ .3	40 43 3.29	- 6 39.85	+ 21	- 2	- 14	9	23.58	75.4
	2		6.8187 ii	31.2177 iv	— 41	.0	+ .2	40 46 41.47	—10 16.87	— 95	+ 2	—24	11	23.54	
	3		7.4980 ii	32.6020 iv	- 2	+ 1.7	+ .2	40 25 46.80	+ 10 34.80	+ 94	+ 30	+ 18	5	23.07	
	4		6.9937 ii	31.8797 iv	- 23	+ .8	.0	40 25 52.75	+ 10 29.23	+ 95	+ 13	+ 19	6	23.31	73.9
	5		26.1163	11.6037	+ 35	— .1	— .3	40 31 32.08	+ 4 51.20	— 15	- 5	+ 10	7	23.25	
	6		19.3837	23.1080	+ 40	- 1.1	- .3	40 37 57.36	- 1 31.28	+ 5	— 21	- 3	6	22.95	73.5
	7		21.5640	19.8287	- 9	+ .2	.0	40 37 6.40	- 43.90	+ 2	+ 3	- 1	6	22.60	
	8		16.8610	23.3503	- 6	- .9	.0	40 33 38.96	+ 2 44.11	- 9	— 14	+ 4	6	22.94	
June	9		14.5917	28.5303	+ 188	- 1.2	- .8	40 42 16.43	- 5 52.86	+ 19	— 29	—10	5	23.42	74.3
7	II 1	D	18.3887	24.8287	+ 89	+ 1.4	+ 1.1	40 39 5.92	— 2 43.07	+ 9	+ 36	- 4	6	23.32	62.8
	2		22.5760	17.3740	- 1	+ .4	+ .6	40 38 34.13	- 2 11.54	+ 7	+ 14	- 3	6	22.83	63.4
	3		22.5817	20.2090	+ 29	+ .4	+ 1.1	40 35 22.19	+ 1 0.07	— 3	+ 20	+ 3	6	22.52	63.1
	4		21.6313	19.4920	+ 8	+ .9	+ 1.5	40 37 16.29	— 0 54.12	+ 3	+ 33	— 2	7	22.58	
	5		20.3100	20.6490	+ 1	+ .5	+ .3	40 36 30.87	- 8.57	+ 0	+ 12	0	8	22.50	62.3
	6		32.1707 iv	9.2097 i	+ 17	+ 1.5	.0	40 46 4.62	+ 9 40.65	— 97	+ 24	—17	6	23.13	
	7		14.0543	25.9080	- 5	+ .4	.0	40 41 21.85	— 4 59.73	+ 16	+ 6	— 9	6	22.31	60.9
	8		9.7050 i	30.4540 iv	- 1	+ 2.0	+ 1.9	40 27 36.79	+ 8 44.68	+ 1.00	+ 56	+18	8	23.29	
	9		19.8670	23.1610	- 41	+ 1.1	+ .4	40 34 59.46	+ 1 23.48	— 5	+ 22	+ 3	6	23.20	

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
June								° ′ ″						° ′ ″	°
7	II 10	D	13.0063	28.7970	+125	+1.4	+ .2	40 29 43.26	+ 6 39.61	— 21	+ 25	+12	6	40 36 23.09	60.6
	III 1	D	13.2877	29.2020	+172	+ .2	+ .1	40 43 5.57	— 6 42.86	+ 21	+ 4	—14	9	22.91	59.8
	2		32.7150iv	8.2147 ii	+ 18	+ .6	+ .6	40 46 43.72	—10 19.58	— 95	+ 17	—24	11	23.26	57.8
	3		34.6850iv	9.6937 ii	+ 96	— .9	— .4	40 25 49.37	+10 32.19	+ 94	— 19	+18	5	22.54	
	4		32.5980iv	7.7937 ii	+ 9	—1.8	—1.5	40 25 55.28	+10 27.24	+ 95	— 48	+19	6	23.24	
	5		13.5697	24.9813	— 73	— .3	— .4	40 31 34.50	+ 4 48.38	— 15	— 10	+10	7	22.80	56.6
	6		22.5513	18.7393	+ 22	+ .3	— .8	40 37 59.87	— 1 36.45	+ 5	— 5	— 3	6	23.45	
	7		19.7343	21.5827	+ 9	+1.3	+1.5	40 37 8.83	— 46.76	+ 2	+ 40	— 1	6	22.54	
	8		24.2300	17.8223	+ 58	—1.0	—1.2	40 33 41.46	+ 2 42.18	— 9	— 31	+ 4	6	23.34	
	9		29.0423	15.0190	+247	—1.0	—1.5	40 42 18.86	— 5 55.23	+ 19	— 35	—10	5	23.42	56.8
June															
8	II 1	R	24.1690	17.7060	+ 54	+1.5	+1.2	40 39 6.07	— 2 43.56	+ 9	+ 39	— 4	6	23.01	66.3
	2		18.2847	23.4903	+ 42	+ .8	+ .4	40 38 34.30	— 2 11.74	+ 7	+ 18	— 3	6	22.84	
	3		20.1353	22.5097	+ 28	+ .2	+1.1	40 35 22.37	+ 1 0.11	— 3	+ 17	+ 3	6	22.71	65.1
	4		19.8990	22.0437	+ 18	+ .4	— .2	40 37 16.47	— 54.28	+ 3	+ 4	— 2	7	22.31	
	5		21.3490	21.0060	+ 3	.0	— .5	40 36 31.05	— 8.68	— 0	— 6	0	8	22.39	
	6		9.3100 ii	32.2683iv	+ 20	—1.2	—1.5	40 46 4.82	— 9 40.59	— 97	— 38	—17	6	22.77	
	7		25.2997	13.4573	— 65	— .9	—1.3	40 41 22.08	— 4 59.29	+ 16	— 31	— 9	6	22.61	63.9
	8		30.1337iv	9.3610 ii	— 2	— .4	— .4	40 27 36.99	+ 8 45.27	+1.00	— 11	+18	8	23.41	
	9		22.1797	18.8700	+ 15	+1.2	+ .3	40 34 59.69	+ 1 23.73	— 5	+ 23	+ 3	6	23.69	
	10		28.2003	12.4153	+ 41	+ .2	+ .8	40 29 43.51	+ 6 39.26	— 21	+ 13	+12	6	22.87	63.1
	III 1	R	28.6140	12.7123	+ 91	—1.2	— .8	40 43 5.84	— 6 42.33	+ 21	— 29	—14	9	23.38	61.0
	2		10.0540 ii	34.5417iv	+ 91	— .7	+ .2	40 46 44.06	—10 19.44	— 95	— 8	—24	11	23.46	
	3		6.6037 ii	31.6060iv	— 42	+1.4	.0	40 25 49.68	+10 32.12	+ 94	+ 22	+18	5	23.19	59.8
	4		7.2743 ii	32.0743iv	— 15	— .9	— .4	40 25 55.59	+10 27.07	+ 95	— 19	+19	6	23.67	
	5		28.0053	16.6190	+227	—1.1	— .5	40 31 34.80	+ 4 48.50	— 15	— 24	+10	7	23.08	58.9
	6		18.5807	22.4400	+ 18	— .1	.0	40 38 0.19	— 1 37.63	+ 5	— 1	— 3	6	22.63	58.4
	7		21.4267	19.5900	+ 6	— .2	— .6	40 37 9.35	— 46.46	+ 2	— 10	— 1	6	22.86	
	8		18.3747	24.7207	+ 85	— .7	+ .5	40 33 41.78	+ 2 40.68	— 9	— 4	+ 4	6	22.43	
June	9		13.8253	27.8707	+103	—2.0	—1.2	40 42 19.17	— 5 55.42	+ 19	— 47	—10	5	23.42	58.8
9	II 1	D	17.1897	23.6450	+ 24	.0	— .6	40 39 6.22	— 2 43.29	+ 9	— 7	— 4	6	22.97	69.4
	2		22.1483	16.9603	— 19	.0	.0	40 38 34.44	— 2 11.14	+ 7	0	— 3	6	23.40	69.4
	3		21.9847	19.5997	+ 15	.0	+1.3	40 35 22.55	+ 1 0.35	— 3	+ 16	+ 3	6	23.12	68.6
	4		20.5217	18.3697	— 10	.0	+1.0	40 37 16.63	— 54.39	+ 3	+ 13	— 2	7	22.45	
	5		18.3230	18.6603	— 5	+1.0	+ .7	40 36 31.21	— 8.52	+ 0	+ 25	0	8	23.02	
	6		30.7057iv	7.7273 ii	— 20	+1.2	+ .7	40 46 5.02	— 9 41.00	— 97	+ 28	—17	6	23.22	
	7		14.2023	26.0520	+ 13	.0	+ .2	40 41 22.29	— 4 59.67	+ 16	+ 2	— 9	6	22.77	67.1
	8		9.5247 ii	30.2777iv	— 1	+1.3	+1.7	40 27 37.19	+ 8 44.77	+1.00	+ 43	+18	8	23.65	
	9		16.7587	20.0343	— 47	+ .7	+1.1	40 34 59.91	+ 1 22.71	— 5	+ 25	+ 3	6	22.91	
	10		12.5320	28.2913	+ 55	.0	+ .4	40 29 43.74	+ 6 38.64	— 21	+ 5	+12	6	22.40	65.6
	III 2	D	30.5783iv	6.0607 ii	— 66	— .2	— .4	40 46 44.23	—10 19.80	— 95	— 8	—24	11	23.27	65.8
	3		34.4747iv	9.5160 ii	+ 88	— .7	+ .2	40 25 49.98	+10 31.35	+ 94	— 8	+18	5	22.42	
	4		31.2170iv	6.4213 ii	— 53	—1.9	—1.4	40 25 55.88	+10 26.87	+ 95	— 48	+19	6	23.47	63.6
	5		13.0320	24.4347	—127	— .5	— .7	40 31 35.08	+ 4 48.02	— 15	— 17	+10	7	22.95	
	6		22.3390	18.4723	+ 13	— .7	— .4	40 38 0.48	— 1 37.81	+ 5	— 16	— 3	6	22.59	63.1
	7		19.2793	21.1253	+ 1	— .7	— .8	40 37 9.65	— 46.68	+ 2	— 21	— 1	6	22.83	63.2
	8		25.6367	19.2757	+134	—1.6	— .4	40 33 42.08	+ 2 41.19	— 9	— 30	+ 4	6	22.98	
June	9		27.7983	13.7207	+ 93	— .2	— .4	40 42 19.47	— 5 56.21	+ 19	— 8	—10	5	23.32	62.4
11	II 1	R	24.8550	18.3853	+ 91	+1.6	+1.2	40 39 6.51	— 2 43.83	+ 9	+ 41	— 4	6	23.20	71.3
	2		17.5980	22.8203	+ 9	.0	.0	40 38 34.76	— 2 12.08	+ 7	0	— 3	6	22.78	70.3
	3		19.5537	21.9357	+ 14	— .6	— .9	40 35 22.89	+ 1 0.27	— 3	— 21	+ 3	6	23.01	
	4		20.1167	22.2550	+ 22	+ .9	.0	40 37 16.95	— 54.13	+ 3	+ 14	— 2	7	23.04	
	5		21.2330	20.8940	+ 1	—1.8	— .8	40 36 31.53	— 8.57	0	— 39	0	8	22.65	
	6		8.9250 ii	31.8933iv	+ 11	—1.6	— .6	40 46 5.40	— 9 40.82	— 97	— 33	—17	6	23.17	
	7		26.3537	14.4820	+ 43	+1.1	+ .4	40 41 22.69	— 5 0.31	+ 16	+ 22	— 9	6	22.73	70.1
	8		31.1360iv	10.3847 ii	+ 2	+ .1	— .5	40 27 37.56	+ 8 44.74	+1.00	— 5	+18	8	23.51	

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
June								° ′ ″						° ′ ″	°
11	II 9	R	22.5973	19.3177	+ 27	+ .4	+ .7	40 35 0.33	+ 1 23.00	— 5	+ 15	+ 3	6	40 36 23.52	
	10		28.9590	13.2180	+ 148	+ .5	+ .3	40 29 41.18	+ 6 38.41	— 21	+ 12	+ 12	6	22.68	69 6
	III 1	R	29.8933	13.9723	+ 268	— .6	+ .3	40 43 6.55	— 6 43.27	+ 21	— 5	—14	9	23.39	67.6
	2		8.4637 ii	32.9933 iv	+ 28	— .2	.0	40 46 44.69	10 20.34	— 95	— 3	—24	11	23.24	67.9
	3		7.7077 ii	32.6773 iv	+ 8	+1.6	+ .4	40 25 50.53	+ 10 31.42	+ 94	+ 30	+ 18	5	23.42	
	4		6.3417 ii	31.0987 iv	— 56	+ .1	+ .2	40 25 56.42	+ 10 25 88	+ 95	+ 4	+ 19	6	23.54	
	5		26.7723	15.4273	+ 108	— .2	— .6	40 31 35.61	+ 4 47.15	— 15	— 10	+ 10	7	22.68	67.7
	6		19.9240	23 7963	+ 64	—1.9	—2.1	40 38 1.04	— 1 38.08	+ 5	— 57	— 3	6	22.47	
	7		20.3847	18.5023	— 8	+ .6	— .1	40 37 10.19	— 47.58	+ 2	+ 8	— 1	6	22.76	67.1
	8		17.1523	23.4870	— 8	— .3	.0	40 33 42.54	+ 2 40.16	— 9	— 5	+ 4	6	22.66	
June	9		12.8070	26.8940	— 19	—2.1	— .7	40 42 20.02	— 5 56.17	+ 19	— 42	—10	5	23.57	67.1
11	II 1	D	17.7133	24.1957	+ 55	— .7	—1.6	40 39 7.02	— 2 44.06	+ 9	— 31	— 4	6	22.76	75.9
	2		22.9047	17.6637	+ 13	+ 1.0	— .1	40 38 35.31	— 2 12.56	+ 7	+ 14	— 3	6	22.99	
	3		21.6937	19.3387	+ 13	—1.9	.0	40 35 23.47	+ 59.58	— 3	— 30	+ 3	6	22.81	75.4
	4		21.4490	19.2847	+ 5	— .6	— .1	40 37 17.50	— 54.74	+ 3	— 11	— 2	7	22.73	75.6
	5		20.8583	21.2117	+ 1	— .6	—1.8	40 36 32.09	— 9.01	+ 0	— 32	0	8	22.84	
	6		31.6827 iv	8.6793 ii	+ 4	+ .9	+ .2	40 46 6.04	— 9 41.69	— 97	+ 17	—17	6	23 44	75.1
	7		15.3190	27.1960	+ 129	—1.1	— .2	40 41 23.36	— 5 0.66	+ 16	— 20	— 9	6	22.63	74.6
	8		9.6980 ii	30.4120 iv	+ 1	— .2	+ 1.8	40 27 38.18	+ 8 43.79	+ 1.00	+ 33	+ 18	8	23.56	
	10		14.2817	29.9997	+ 292	+ .9	.0	40 29 44.91	+ 6 38.20	— 21	+ 14	+ 12	6	23.22	73.3
June															
16	II 1	R	24.2227	17.7297	+ 55	— .1	— .4	40 39 7.41	— 2 44.33	+ 9	+ 6	— 4	6	23.25	68.2
23	II 1	R	23.7130	17.2060	+ 27	+ .4	+ .8	40 39 8.11	— 2 45.37	+ 9	+ 16	— 4	6	23.01	75.6
	2		17.8683	23.1787	+ 24	+ 1.4	+ 1.1	40 38 36.77	— 2 14.34	+ 7	+ 36	— 3	6	22.89	
	3		19.7780	22.0123	+ 17	+ 1.7	+ .4	40 35 25.10	+ 57.30	— 3	+ 32	+ 3	6	22.78	75.4
	4		22.5267	24.7527	+ 71	— .6	— .1	40 37 19.07	— 56.47	+ 3	— 11	— 2	7	22.57	74.6
	5		21.3457	20.9237	+ 3	— .4	—1.2	40 36 33.69	— 10.68	— 0	— 22	0	8	22.87	
	6		8.3750 ii	31.4657 iv	— 3	+ .6	+ .1	40 46 7.92	— 9 43.88	— 97	+ 11	—17	6	23.07	
	7		27.1063	15.1240	+ 116	+ 1.6	+ .6	40 41 25.39	— 5 3.29	+ 16	+ 33	— 9	6	22.56	72.6
	8		31.2247 iv	10.5940 ii	+ 3	— .2	— .1	40 27 39.88	+ 8 41.69	+ 1.00	— 4	+18	8	22.79	72.4
	9		23.1967	20.0357	+ 45	+ 1.2	+ .7	40 35 3.16	+ 1 20.05	— 5	+ 28	+ 3	6	23.53	
June	10		27.7537	12.1127	— 10	+ 1.4	+ 1.3	40 29 47.17	+ 6 35.48	— 21	+ 39	+ 12	6	23.01	70.5
25	III 1	D	14.1517	30.2363	+ 309	+ .1	.1	40 43 10.23	— 6 47.43	+ 21	0	—14	9	22.96	70,4
	2		32.4520 iv	7.7807 ii	+ 6	— .7	— .9	40 46 48.38	—10 23.87	— 95	— 22	—24	11	23.21	70.4
	3		33.8760 iv	9.0720 ii	+ 63	—3.2	—2.5	40 25 54.86	+ 10 27.37	+ 94	— 83	+ 18	5	22.57	
	4		31.4643 iv	9.6690 ii	+ 87	— .8	— .3	40 26 0.70	+ 10 22.16	+ 95	— 17	+ 19	6	23.89	
	5		13.7650	24.9910	— 62	+ .2	—1.1	40 31 39.76	+ 4 43.71	— 15	— 11	+ 10	7	23,38	
	6		21.5280	17.4810	— 19	— .4	—1.0	40 38 5.37	— 1 42.29	+ 5	— 19	— 3	6	22.97	70.2
	7		20.9603	23.0240	+ 35	— .6	— .2	40 37 14.59	— 52.27	+ 2	— 12	— 1	6	22.27	70.4
	8		21.1300	17.9380	+ 57	—2.2	—1.8	40 33 47.07	+ 2 36.72	— 9	— 58	+ 4	6	23.22	
	9		26.0660	11.7820	—135	— .4	— .9	40 42 24.38	— 6 0.85	+ 19	— 18	—10	5	23.49	70.2
June															
28	II 2	D	21.2943	15.9797	— 64	—1.2	— .9	40 38 37.37	— 2 14.23	+ 7	— 31	— 3	6	22.93	72.8
	3		21.7467	19.5137	+ 11	— .8	+ 1.0	40 35 25.81	+ 56.49	— 3	0	+ 3	6	22.36	72.6
	4		21.2100	18.9697	+ 1	+ .8	+ 1.7	40 37 19.75	— 57.41	+ 3	+ 35	— 2	7	22.77	
	5		20.1957	20.6820	+ 2	+1.2	+ .5	40 36 34.35	— 12.30	— 0	+ 26	0	8	22.39	
	6		32.3000 iv	9.1687 ii	+ 20	+ 1.0	+ .6	40 46 8.72	— 9 44.97	— 97	+ 23	—17	6	22.90	72.4
June															
29	II 2	R	17.4157	22.7307	+ 3	— .4	— .8	40 38 37.52	— 2 14.41	+ 7	— 18	— 3	6	23.03	75.5 *a*
	3		20.1890	22.4210	+ 26	+ .6	+ .2	40 35 25.96	+ 56.51	— 3	+ 12	+ 2	6	22.64	
July	4		21.0497	23.3063	+ 44	—1.0	—1.5	40 37 19.89	— 57.17	+ 3	— 40	— 2	7	22.40	72.3
9	III 1	D	12.0237	28.2757	+ 21	+ 3.3	+ 1.5	40 43 13.66	— 6 51.01	+ 24	+ 72	—15	9	23.55	70.6
	2		32.5520 iv	7.7333 ii	+ 7	— .1	+ .3	40 46 51.87	—10 27.60	— 91	+ 2	—25	11	23.24	69.6
	3		32.3327 iv	7.7103 ii	+ 1	—1.6	— .7	40 25 59.02	+ 10 22.62	+ 92	— 34	+ 18	5	22.45	
	4		33.4710 iv	9.0440 ii	+ 50	—2.6	—1.8	40 26 4.84	+10 17.81	+ 92	— 64	+ 19	6	23 18	
	5		14.2653	25.3157	— 21	— .5	— .8	40 31 43.83	+ 4 39.38	— 16	— 18	+ 9	7	23.03	69.4
	6		21.6767	17.4547	— 17	+ .6	+ .1	40 38 9.80	— 1 46.72	+ 6	+ 12	— 3	6	23.29	68.7
	7		18.4700	20.6940	— 7	—1.0	—1.2	40 37 19.00	— 56.22	+ 4	— 31	— 2	6	22.55	

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Ther. mom.
July								° ′ ″						° ′ ″	°
9	III 8	D	22.4037	16.4300	— 32	+ 1.2	+ 1.6	40 33 51.56	+ 2 30.97	— 9	+ 40	+ 4	6	40 36 22.94	
	9		26.9293	12.4327	— 46	+ 1.6	+ .2	40 42 28.86	— 6 6.46	+ 22	+ 28	—10	5	22.85	68.1
	IV 1	D	19.8273	17.8827	— 18	— .3	— .6	40 37 12.07	— 49.13	+ 3	— 12	— 2	13	22.96	63.6
	2		21.5510	22.9260	+ 27	—3.3	—2.7	40 36 58.27	— 34.84	+ 2	— 87	— 2	11	22.67	
	3		12.6893	28.8013	+ 105	+ .6	— .6	40 29 34.94	+ 6 47.69	— 23	+ 2	+12	7	22.61	64.0
	4		22.9277	17.3900	+ 7	— .4	— .4	40 38 42.38	— 2 20.05	+ 8	— 11	— 5	10	22.35	63.6
	5		12.4733	29.0767	+ 110	.0	—1.3	40 29 22.33	+ 7 0.12	— 24	— 16	+ 12	6	22.23	63.2
	6		30.6843[iv]	11.6910[ii]	— 9	— .9	+ .1	40 28 21.38	+ 8 0.26	+1.00	— 13	+13	5	22.69	
	7		14.0257	28.6473	+ 171	+1.7	+1.7	40 30 12.25	+ 6 10.17	— 21	+ 49	+ 10	6	22.86	
	8		27.8570	11.4503	— 50	— .5	— .5	40 43 18.07	— 6 54.75	+ 24	— 14	—13	7	23.36	62.9
	9		18.9233	22.7583	+ 28	+2.4	+3.1	40 37 58.95	— 1 37.05	+ 6	+ 78	— 3	11	22.82	
	10		17.0430	26.5627	+ 151	—1.1	+ .2	40 40 24.22	— 4 1.10	+ 14	— 15	— 7	6	23.10	61.9
July	11		6.2153[ii]	33.5000[iv]	— 9	+1.8	— .1	40 24 51.80	+11 29.92	+ 88	+ 27	+ 20	6	23.13	61.8*
10	III 1	R	27.9793	11.7290	— 22	—5.3	+ .7	40 43 13.86	— 6 50.86	+ 24	+ 17	—15	9	23.35	60.9
	2		7.5500[ii]	32.5703[iv]	+ 3	— .6	+ .1	40 46 52.08	—10 27.63	— 91	— 8	—25	11	23.32	62.6
	3		8.4627[ii]	33.0730[iv]	+ 24	+1.1	+ .1	40 25 59.27	+10 22.38	+ 92	+ 19	+ 18	5	22.99	62.0
	4		8.2467[ii]	32.6333[iv]	+ 17	+ .2	— .4	40 26 5.09	+10 16.70	+ 92	— 2	+ 19	6	22.94	
	5		25.9017	14.8890	+ 39	- .4	+ .4	40 31 44.08	+ 4 38.57	— 16	— 1	+ 9	7	22.64	61.1
	6		18.7977	23.0333	+ 34	+ .2	+ .8	40 38 10.07	— 1 47.19	+ 6	+ 13	— 3	6	23.10	60.4
	7		22.3383	20.0600	+ 24	+1.8	+1.4	40 37 19.28	— 57.67	+ 4	+ 47	— 2	6	22.16	60.0
	8		18.6297	24.5760	+ 84	+ .6	+ .9	40 33 51.84	+ 2 30.58	— 9	+ 21	+ 4	6	22.64	
July	9		13.0013	27.4973	+ 33	+1.7	+1.6	40 42 29.24	— 6 6.64	+ 22	+ 48	—10	5	23.25	59.3
12	III 1	D	12.9390	29.1983	+ 159	+ .8	+ .2	40 43 14.29	— 6 51.55	+ 24	+ 15	—15	9	23.07	66.8
	2		34.2687[iv]	9.4357[ii]	+ 78	.0	.0	40 46 52.52	—10 28.14	— 91	0	—25	11	23.33	
	3		33.3723[iv]	8.7760[ii]	+ 45	—2.0	—1.0	40 25 59.81	+10 22.07	+ 92	— 45	+ 18	5	22.58	
	4		34.8713[iv]	10.5027[ii]	+ 102	— .2	—1.0	40 26 5.62	+10 16.46	+ 92	— 16	+ 19	6	23.09	
	5		13.8503	24.8830	— 62	— .3	— .6	40 31 44.60	+ 4 38.82	— 16	— 12	+ 9	7	23.30	66.1
	6		21.9190	17.6607	— 8	+ .8	—1.1	40 38 10.63	— 1 47.66	+ 6	— 1	— 3	6	23.05	
	7		18.1017	20.3673	— 15	+ .1	+ .1	40 37 19.84	— 57.25	+ 4	+ 3	— 2	6	22.70	66.4
	8		23.8583	17.9020	+ 47	—1.4	—2.0	40 33 52.41	+ 2 30.73	— 9	— 48	+ 4	6	22.67	65.8
	9		26.2900	11.7940	—120	—1.4	—1.2	40 42 29.70	— 6 6.25	+ 22	— 43	—10	5	23.19	65.8
	IV 1	R	21.3387	23.3067	+ 42	— .2	— .1	40 37 12.77	— 49.87	+ 3	— 4	— 2	13	23.00	64.1*a*
	2		20.4257	19.0227	— 2	—1 6	—1.5	40 36 58.99	— 35.47	+ 2	— 44	— 2	11	23.19	65.0
	3		28.3563	12.2670	+ 40	— .5	.0	40 29 35.72	+ 6 46.96	— 23	— 8	+ 12	7	22.56	*a*
	4		19.4160	24.9667	+ 105	+ .2	+ .6	40 38 43.09	— 2 20.62	+ 8	+ 10	— 5	10	22.70	64.3
	5		28.7690	12.1747	+ 67	— .3	.0	40 29 23.11	+ 6 59.79	— 24	— 5	+ 12	6	22.79	
	6		10.4300[ii]	29.3837[iv]	0	+1.8	+1.1	40 28 22.15	+ 7 59.28	+1.00	+ 43	+ 13	5	23.04	64.3
July	8		13.3633	29.7870	+ 225	+ .4	+ .5	40 43 18.79	— 6 55.87	+ 24	+ 13	—13	7	23.23	64.3*d*
16	III 1	R	31.3050	15.0590	+ 450	— .6	+ .1	40 43 15.30	— 6 51.95	+ 24	— 8	—15	9	23.45	65.3
	2		8.0400[ii]	32.9140[iv]	+ 20	—1.1	— .1	40 46 53.56	—10 29.03	— 91	— 19	—25	11	23.29	
	3		5.9057[ii]	30.4547[iv]	— 72	+1.6	+1.9	40 26 1.03	+10 20.58	+ 92	+ 50	+ 18	5	23.26	
	4		5.8500[ii]	30.1907[v]	— 75	— .6	.0	40 26 6.84	+10 15.31	+ 92	— 9	+ 19	6	23.23	
	7		22.7703	20.4620	+ 33	— .5	— .3	40 37 21.16	— 58.45	+ 4	— 12	— 2	6	22.67	66.1
	8		19.3490	25.2287	+ 118	— .5	+ .6	40 33 53 75	+ 2 28.98	— 9	0	+ 4	6	22.74	
	9		12.5180	27.0713	— 29	—1.1	— .4	40 42 31.04	— 6 7.93	+ 22	— 22	—10	5	23.06	64.6
	IV 1	D	18.2037	16.1787	— 51	+ .5	— .1	40 37 13.90	— 51.08	+ 3	+ 6	— 2	13	23.02	64.4
	2		21.0527	22.5147	+ 24	— .3	+1.2	40 37 0.13	— 37.03	+ 2	+ 10	— 2	11	23.31	
	3		16.8137	32.8353	+ 672	— .4	— .6	40 29 36.94	+ 6 46.83	— 23	— 14	+12	7	23.59	
	4		22.5293	16.9120	— 15	+ .5	— .2	40 38 44.22	— 2 22.01	+ 8	+ 5	— 5	10	22.39	64.4
	5		12.2793	28.8373	+ 79	— .5	—1.5	40 29 24.33	+ 6 58.90	— 24	— 27	+ 12	6	22.90	
	6		30.6567[iv]	11.7233[ii]	— 11	—3 0	—1.9	40 28 23.34	+ 7 58.74	+1.00	— 72	+13	5	22.54	64.1
	7		13.2600	27.8180	+ 67	+1.0	+1.3	40 30 14.17	+ 6 8.29	— 21	+ 32	+10	6	22.73	
	8		27.1617	10.6780	—156	+ .7	— .6	40 43 19.88	— 6 56.42	+ 24	+ 3	—13	7	23.67	
	9		18.0097	21.8687	— 2	— .2	— .9	40 38 0.52	— 1 37.58	+ 6	— 14	— 3	11	22.94	
	10		16.1557	25.7617	+ 80	— .7	— .1	40 40 25 94	— 4 3.11	+ 14	— 12	— 7	6	22.84	63.8

* Hurried and e. e. f.

1895.	Star.	P	Micrometer.		O	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
July								° ′ ″						° ′ ″	°
16	IV 11	D	6.9623 II	34.1857 IV	+ 39	— .1	— .1	40 24 53.44	+11 28.49	+ 88	— 3	+20	6	40 36 23.04	
July 12			26.0337	13.5750	— 25	+ .2	—1.8	40 41 37.31	— 5 14.98	+ 19	— 20	—10	7	22.29	64.0
18	III 1	D	13.2100	29.5270	+192	+ .7	+1.1	40 43 15.79	— 6 53.09	+ 24	+ 25	—15	9	23.13	69.8
	2		33.3750 IV	8.4653 II	+ 41	+ .9	—1.4	40 46 54.07	—10 29.99	— 91	— 3	—25	11	23.00	68.6
	3		33.7343 IV	9.2313 II	+ 59	—1.0	—1.3	40 26 1.63	+10 19.75	+ 92	— 32	+18	5	22.21	
	4		32.4790 IV	8.1763 II	+ 13	— .5	— .7	40 26 7.45	+10 14.57	+ 92	— 17	+19	6	23.02	
	5		14.6930	25.6330	+ 16	— .6	— .5	40 31 46.42	+ 4 36.68	— 16	— 16	+ 9	7	22.94	67.3
	6		22.0387	17.7177	— 6	.0	.0	40 38 12.58	— 1 49.25	+ 6	0	— 3	6	23.42	
	7		18.9940	21.5243	+ 5	—2.0	— .2	40 37 21.83	— 58.94	+ 4	— 34	— 2	6	22.63	67.6
	8		22.8820	17.0163	— 2	— .4	— .1	40 33 54.44	+ 2 28.32	— 9	— 8	+ 4	6	22.69	
	9		28.0423	13.4737	+ 96	+ 6	—1.2	40 42 31.73	+ 6 8.64	+ 22	— 6	—10	5	23.20	66.4
	IV 1	D	21.5750	23.5943	+ 48	— .5	— .7	40 37 14.52	— 51.18	+ 3	— 17	— 2	13	23.31	63.9
	2		17.8937	16.4080	— 39	—1.7	—2.1	40 37 0.78	— 37.47	+ 2	— 54	— 2	11	22.88	
	3		30.4107	14.4193	+335	—1.9	— .1	40 29 37.63	+ 6 45.22	— 23	— 32	+12	7	22.49	
	4		18.1380	23.7790	+ 48	—1.1	+ .2	40 38 44.87	— 2 22.76	+ 8	— 15	— 5	10	22.09	63.5
	5		29.1507	12.6387	+128	—1.3	— .2	40 29 25.03	+ 6 57.86	— 24	— 23	+12	6	22.60	63.5
	6		10.1543 II	29.0247 IV	+ 3	+3.0	+1.3	40 28 24.02	+ 7 57.18	+1.00	+ 64	+13	5	23.02	62.5
	7		27.9000	13.3703	+ 80	— .8	— .3	40 30 14.85	+ 6 7.61	— 21	— 17	+10	6	22.24	
	8		10.9790	27.4700	—111	—2.0	— .5	40 43 20.53	— 6 56.72	+ 24	— 38	—13	7	23.61	
	9		21.5653	17.6790	— 14	— .5	— .8	40 38 1.09	— 1 38.24	+ 6	— 18	— 3	11	22.81	62.0
	10		24.8950	15.2590	+ 6	+1.1	.0	40 40 26.56	— 4 3.68	+ 14	+ 17	— 7	6	23.18	61.7
	11		33.7223 IV	6.5180 II	+ 7	+ .2	— .1	40 24 54.04	+11 27.93	+ 88	+ 1	+20	6	23.12	
July	12		13.0230	25.4820	— 80	—1.3	— .6	40 41 37.89	— 5 14.85	+ 19	— 28	—10	7	22.92	61.5
19	III 1	R	30.5280	14.2153	+334	—2.0	— .1	40 43 16.02	— 6 53.84	+ 24	— 33	—15	9	22.53	73.0
	2		7.7627 II	32.6903 IV	+ 10	+ .5	+ .4	40 46 54.29	—10 30.36	— 91	+ 13	—25	11	23.01	73.1
	3		8.0710 II	32.5827 IV	+ 14	+ .5	— .6	40 26 1.80	+10 19.86	+ 92	0	+18	5	22.81	
	4		6.4067 II	30.7310 IV	— 55	—1.6	+ .1	40 26 7.72	+10 14.94	+ 92	— 24	+19	6	23.59	
	5		26.7590	15.8650	+123	— .2	+ .1	40 31 46.69	+ 4 35.78	— 16	— 1	+ 9	7	22.46	72.9
	6		19.5070	23.8530	+ 64	—1.0	— .3	40 38 12.88	— 1 50.06	+ 6	— 20	— 3	6	22.71	72.5
	7		21.2237	18.8640	0	— .2	.0	40 37 22.14	— 59.67	+ 4	— 3	— 2	6	22.52	72.4
	8		16.5063	22.3580	— 30	— .2	.0	40 33 54.76	+ 2 27.89	— 9	— 3	+ 4	6	22.63	
	9		12.4827	27.0873	— 28	— .9	— .1	40 42 32.05	— 6 9.23	+ 22	— 16	—10	5	22.83	72.0
	IV 1	D	19.5510	17.5103	— 26	+ .8	.0	40 37 14.83	— 51.54	+ 3	+ 13	— 2	13	23.56	69.0
	2		19.0267	20.5213	— 2	—1.1	— .4	40 37 1.10	— 37.79	+ 2	— 22	— 2	11	23.20	
	3		11.8460	27.8400	— 21	+1.1	+ .2	40 29 37.96	+ 6 44.38	— 23	+ 20	+12	7	22.50	68.9
	4		22.4010	16.7307	— 22	+1.0	+2.4	40 38 45.19	— 2 23.33	+ 8	+ 46	— 5	10	22.45	
	5		13.1947	29.6737	+207	— .3	+ .2	40 29 25.37	+ 6 57.22	— 24	— 2	+12	6	22.51	
	6		29.3150 IV	10.4323 II	+ 1	— .5	— .2	40 28 24.37	+ 7 57.48	+1.00	— 10	+13	5	22.93	69.2
	7		11.9517	26.5033	— 98	— .3	— .7	40 30 15.18	+ 6 7.71	— 21	— 14	+10	6	23.70	
	8		28.1620	11.6517	— 15	— .1	—1.2	40 43 20.86	— 6 57.45	+ 24	— 17	—13	7	22.42	
	9		19.1933	23.0897	+ 39	+ .9	+ .4	40 38 1.38	— 1 38.63	+ 6	+ 19	— 3	11	23.08	*a d*
	10		15.0010	24.6553	— 14	—1.6	+ .3	40 40 26.87	— 4 4.09	+ 14	— 21	— 7	6	22.70	68.6
	11		5.5497 II	32.7537 IV	— 55	+ .3	—1.1	40 24 54.34	+11 27.76	+ 88	— 9	+20	6	23.15	68.2
July	12		24.7913	12.3107	—159	— .6	—1.6	40 41 38.18	— 5 15.19	+ 19	— 30	—10	7	22.85	
25	III 1	D	10.5623	26.9563	—178	— .2	— .3	40 43 17.08	— 6 54.10	+ 24	— 7	—15	9	23.04	65.5
	2		32.7280 IV	7.7433 II	+ 11	+ .8	.0	40 46 55.39	—10 31.81	— 91	+ 13	—25	11	22.66	65.6
	3		33.5090 IV	9.0507 II	+ 51	—2.1	—1.6	40 26 3.29	+10 18.60	+ 92	— 54	+18	5	22.50	
	4		33.6920 IV	9.4420 II	+ 59	+ .3	— .6	40 26 9.00	+10 13.35	+ 92	— 2	+19	6	23.50	
	5		14.2367	25.1063	— 31	.0	— .1	40 31 48.10	+ 4 34.78	— 16	— 1	+ 9	7	22.87	
	6		21.8037	17.3993	— 16	+ .8	—1.2	40 38 14.43	— 1 51.33	+ 6	— 2	— 3	6	23.17	65.1
	7		18.1513	20.5780	— 13	+ .5	+1.1	40 37 23.74	— 1 1.33	+ 4	+ 25	— 2	6	22.74	
	8		23.6043	17.8143	+ 37	+ .2	+ .7	40 33 56.41	+ 2 26.50	— 9	+ 14	+ 4	6	23.06	
	9		27.0430	12.3773	+ 38	+1.4	— .1	40 42 33.73	— 6 10.75	+ 22	+ 21	—10	5	23.36	65.2
	IV 1	R	20.5073	22.6213	+ 28	+ .2	— .4	40 37 16.42	— 53.53	+ 3	— 2	— 2	13	23.01	65.0*a*
	2		22.1343	20.5603	+ 18	—2.3	—1.3	40 37 2.75	— 39.85	+ 2	— 53	— 2	11	22.48	

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
July								° ′ ″						° ′ ″	°
25	IV 3	R	29.4373	13.5297	+204	— .2	—1.0	40 29 39.77	+ 6 42.77	— 23	— 16	+ 12	7	40 36 22.34	64.8
	4		19.8973	25.5920	+137	+ .3	+1.8	40 38 46.87	— 2 24.35	+ 8	+ 28	— 5	10	22.93	
	6		10.6597 ii	29.4570 iv	0	+1.7	+ .9	40 28 26.22	+ 7 55.32	+1.00	+ 39	+13	5	23.11	
	7		28.6550	14.2217	+182	— .4	+1.0	40 30 17.01	+ 6 5.43	— 21	+ 6	+10	6	22.45	65.0
	8		12.4197	29.0093	+100	+ .5	+ .4	40 43 22.51	— 6 59.75	+ 24	+ 13	—13	7	23.07	
	9		24.7970	20.8520	+ 98	— .2	— .6	40 38 2.94	— 1 40.00	+ 6	— 10	— 3	11	22.98	
	10		25.5073	15.7847	+ 55	+3.0	+ .7	40 40 28.60	— 4 5.99	+ 14	+ 57	— 7	6	23.31	64.3
	11		35.9090 iv	8.8307 ii	+146	.0	+ .9	40 24 56.01	+11 25.09	+ 88	+ 11	+20	6	22.35	
July	12		18.8173	26.3633	+ 10	+ .6	+ .7	40 41 39.80	— 5 17.27	+ 19	+ 18	—10	7	22.87	63.9
26	III 1	R	29.2993	12.9080	+158	— .4	+2.0	40 43 17.22	— 6 54.88	+ 24	+ 19	—15	9	22.71	67.7
	3		7.2390 ii	31.7020 iv	— 20	— .5	+ .7	40 26 3.54	+10 18.54	+ 92	+ 1	+18	5	23.24	67.1
	4		6.1810 ii	30.4230 iv	— 63	— .6	— .2	40 26 9.35	+10 12.83	+ 92	— 12	+19	6	23.23	
	5		26.7430	15.8850	+124	— .4	— .3	40 31 48.35	+ 4 34.88	— 16	— 10	+ 9	7	23.13	66.6
	6		17.9550	22.3813	+ 9	— .1	— .6	40 38 14.70	— 1 51.95	+ 6	— 9	— 3	6	22.75	66.2
	7		22.8047	20.3718	+ 33	+1.1	+ .5	40 37 24.01	— 1 1.62	+ 4	+ 24	— 2	6	22.71	
	8		19.1297	24.8847	+101	— .9	+ .6	40 33 56.69	+ 2 25.78	— 9	— 7	+ 4	6	22.41	
	9		12.4107	27.0937	— 34	—2.7	— .8	40 42 34.01	— 6 11.20	+ 22	— 53	—10	5	22.45	65.3
	IV 2	D	18.3900	19.9953	— 12	+ .4	+1.3	40 37 3.02	— 40.56	+ 2	+ 23	— 2	11	22.80	63.4
	3		11.3733	27.3597	— 87	+1.4	+ .9	40 29 40.06	+ 6 44.02	— 23	+ 34	+12	7	[24.38]	a
	4		22.0520	16.3117	— 43	+ .1	— .1	40 38 47.14	— 2 25.04	+ 8	0	— 5	10	22.23	61.9
	5		13.0350	29.4503	+179	— .1	— .1	40 29 27.52	+ 6 55.54	— 24	— 3	+12	6	22.97	
	6		30.8380 iv	12.0330 ii	— 15	—1.2	—1.0	40 28 26.50	+ 7 55.48	+1.00	— 32	+13	5	22.84	62.1
	7		12.0357	26.4800	— 92	+2.0	+ .7	40 30 17.30	+ 6 5.02	— 21	+ 41	+10	6	22.68	
	8		27.1497	10.5317	—171	+1.1	+1.6	40 43 22.88	— 6 59.78	+ 24	+ 38	—13	7	23.66	
	9		19.0470	28.0028	+ 35	— .7	.0	40 38 3.18	— 1 40.11	+ 6	— 11	— 3	11	23.10	a
	10		16.6413	26.3470	+127	—2.0	—1.0	40 40 28.87	— 4 5.76	+ 14	— 45	— 7	6	22.79	61.7
	11		5.4990 ii	32.6350 iv	— 59	— .9	— .2	40 24 56.21	+11 26.03	+ 88	— 17	+20	6	23.21	62.3
July	12		25.5280	12.9683	— 80	+ .3	—1.1	40 41 40.04	— 5 17.39	+ 19	— 9	—10	7	22.72	
28	III 1	R	27.9883	11.5790	— 32	+ .1	+1.0	40 43 17.65	— 6 54.86	+ 24	+ 14	15	9	23.11	66.9
	2		35.9697 iv	10.9867 ii	+153	+ .7	+2.3	40 46 56.04	—10 32.13	— 91	+ 40	—25	11	23.26	
	3		33.4233 iv	9.0243 ii	+ 48	—1.2	+ .6	40 26 4.07	+10 17.09	+ 92	— 12	+18	5	22.19	
	4		32.9283 iv	8.7337 ii	+ 29	+1.4	+ .3	40 26 9.89	+10 11.88	+ 92	+ 26	+19	6	23.20	
	5		14.5187	25.3700	— 5	— .7	—1.2	40 31 48.89	+ 4 34.38	— 16	— 26	+ 9	7	23.01	65.9
	6		21.3193	16.8550	— 38	+2.4	+1.7	40 38 15.28	— 1 52.79	+ 6	+ 60	— 3	6	23.18	65.5
	7		17.8430	20.3017	— 19	+ .2	—1.1	40 37 24.61	— 1 2.12	+ 4	— 11	— 2	6	22.46	
	8		23.8307	18.0833	+ 49	— .8	—1.1	40 33 57.31	+ 2 25 46	— 9	— 27	+ 4	6	22.51	
	9		27.1347	12.4417	— 29	+ .1	—1.4	40 42 34.62	— 6 11.46	+ 22	— 16	—10	5	23.17	64.9
	IV 1	D	18.1193	15.9580	— 54	— .4	— .6	40 37 17.21	— 54.52	+ 3	— 14	— 2	13	22.69	63.1
	2	R	20.7133	19.1380	— 3	—2.2	—2.3	40 37 3.58	— 39.83	+ 2	— 65	— 2	11	23.21	
	3		29.4610	13 5807	+209	— .5	.0	40 29 40.66	+ 6 42.09	— 23	— 8	+12	7	22.63	61.9
	4		20.3200	26.0357	+158	—1.4	— .3	40 38 47.70	— 2 24.93	+ 8	— 26	— 5	10	22.64	
	5		28.0817	11.6823	— 18	— .4	— .1	40 29 28.13	+ 6 54.64	— 24	— 8	+12	6	22.63	
	6		11.5573 ii	30.3250 iv	— 8	+1.4	— .1	40 28 27.11	+ 7 54.55	+1.00	+ 21	+13	5	23.05	61.2
	7		27.5460	13.1203	+ 42	—3.3	—1.6	40 30 17.90	+ 6 4.89	— 21	— 73	+10	6	22.01	
	8		11.1437	27.7483	— 80	—1.3	— .7	40 43 23.47	— 6 59.67	+ 24	— 35	—13	7	23.63	
	9		22.0993	18.1223	+ 3	— .2	—1.1	40 38 3.67	— 1 40.55	+ 6	— 17	— 3	11	23.09	61.0
	10		24.4153	14.6590	— 39	+2.3	+ .6	40 40 29.42	— 4 6.61	+ 14	+ 44	— 7	6	23.38	
	11		35.0520	7.9687	+ 95	—1.2	+ .1	40 24 56.79	+11 25.09	+ 88	— 18	+20	6	22.84	
July	12		12.9930	25.5327	— 80	—1.1	—1.8	40 41 40.54	— 5 16.89	+ 19	— 40	—10	7	23.41	30.5
29	III 1	D	11.4227	27.8497	— 53	+ .8	+ .5	40 43 17.88	— 6 55.25	+ 24	+ 19	—15	9	23.00	70.4
	4	R	5.2773 ii	29.4847 iv	— 95	—1.5	— .6	40 26 10.14	+10 11.89	+ 92	— 31	+19	6	22.89	69.6
	5		25.6340	14.8437	+ 22	— .2	— .2	40 31 49.17	+ 4 32.91	— 16	— 5	+ 9	7	22.03	
	6		18.7197	23.1843	+ 37	—1.0	— .4	40 38 15.59	— 1 52.99	+ 6	— 21	— 3	6	22.48	69.3
	7		20.8363	18.3530	— 10	+1.6	.0	40 37 24.92	— 1 2.77	+ 4	+ 26	— 2	6	22.49	
	8		17.8650	23.6070	+ 38	— .5	+ .2	40 33 57.62	+ 2 25.29	— 9	— 5	+ 4	6	22.87	

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Ther. mom.
July								° ′ ″						° ′ ″	°
29	III 9	R	12.4187	27.1360	— 31	− .6	+ .1	40 42 34.95	— 6 12.07	22	— 8	—10	5	40 36 22.97	68.4
	IV 1		18.0893	20.2773	— 15	+ .8	+ .6	40 37 17.51	— 55.29	3	20	— 2	13	22.56	66.9*a*
	2	D	18.5970	20.2297	— 8	+ .8	+ .4	40 37 3.88	— 41.27	+ 2	18	— 2	11	22.90	
	3		11.7543	27.6473	— 43	+1.0	+ .8	40 29 40.98	+ 6 41.77	— 23	26	+12	7	22.97	66.6*a*
	4		20.4740	14.7033	—121	+ .6	+ .3	40 38 48.01	— 2 25.62	8	13	− 5	10	22.65	
	5		12.1127	28.4800	+ 43	+ .4	.0	40 29 28.46	+ 6 53.98	— 24	+ 6	+12	6	22.44	66.3
	6		30.2137[iv]	11.4463[ii]	— 7	− 1.1	— .1	40 28 27.44	+ 7 54.55	+ 1.00	— 19	+13	5	22.98	
	7		14.2620	28.6530	+184	+ .7	+1.0	40 30 18.22	+ 6 4.37	— 21	+ 24	+10	6	22.78	
	8		29.5047	12.8857	+173	+ .5	— .3	40 43 23.76	— 7 0.68	+ 24	4	13	7	23.30	
	9		17.1607	21.1657	— 31	+ .4	+1.1	40 38 3.95	— 1 41.20	+ 6	+ 20	— 3	11	23.09	65.6*a*
	10		14.9690[ii]	25.6880[iv]	+ 34	.6	+ .6	40 40 29.73	— 4 5.85	— 1.14	2	7	6	22.71	65.6
	11		6.9523[ii]	33.9983[iv]	+ 31	+ .4	+1.1	40 24 57.09	+11 23.98	— 88	20	+20	6	22.41	
July	12		26.9470	14.3907	+ 73	+1.1	+2.2	40 41 40.80	— 5 17.69	+ 19	45	—10	7	23.72	*d a*
30	III 1	R	30.7697	14.3887	+369	1.9	— .8	40 43 18.09	— 6 55.16	+ 24	— 40	—15	9	22.71	66.7
	2		7.4113[ii]	32.4030[iv]	— 4	.7	— .8	40 46 56.50	—10 31.95	— 91	— 21	25	11	23.29	65.2
	3		7.7847[ii]	32.1627[iv]	— 1	+ .6	+1.7	40 26 4.63	+10 16.44	+ 92	+ 31	+ 18	5	22.53	
	4	D	31.9987[iv]	7.8233[ii]	— 4	+ .9	+ .1	40 26 10.44	+10 11.31	+ 92	+ 16	+19	6	23.08	
	5		14.3687	25.1660	— 22	+1.3	+ .3	40 31 49.45	+ 4 32.97	— 16	+ 25	+ 9	7	22.67	64.6
	6		23.2177	18.7677	+ 38	1.2	−2.9	40 38 15.90	— 1 52.62	+ 6	56	— 3	6	22.81	
	7		19.1120	21.5853	+ 6	— .8	— .1	40 37 25.24	— 1 2 56	+ 4	14	- 2	6	22.62	62.1
	8		22.5443	16.8170	— 17	— .1	+ .3	40 33 57.95	+ 2 24.78	— 9	+ 2	+ 4	6	22.76	61.2
July	9		27.2777	12.5310	— 15	+ .3	+ .1	40 42 35.27	— 6 12.86	+ 22	+ 6	-10	5	22.64	61.2
31	III 1	D	11.9273	28.3670	+ 20	— .2	— .2	40 43 18.30	— 6 55.76	+ 24	5	-15	9	22.67	64.0
	2		32.4507[iv]	7.4153[ii]	— 3	+1.4	+ .4	40 46 56.72	—10 33.06	— 91	+ 27	25	11	22.88	63.5
	3		33.5893[iv]	9.2000[ii]	+ 55	-2.2	−2.1	40 26 4.89	+10 16.87	+ 92	- 62	+ 18	5	22.29	
	4	R	5.9393[ii]	30.1293[iv]	— 74	—1.3	—1.1	40 26 10.73	+10 11.50	+ 92	— 35	+ 19	6	23.05	
	5		27.1520	16.3903	+165	.0	— .4	40 31 49.73	+ 4 32.55	— 16	5	+ 9	7	22.23	62.6
	6		19.2770	23.7530	+ 60	.8	— .1	40 38 16.20	— 1 53.34	+ 6	- 14	3	6	22.81	62.1
	7		19.8650	17.3727	— 26	+ .9	— .3	40 37 25.55	— 1 2.96	+ 4	+ 10	— 2	6	22.77	
	8		16.7953	22.5093	— 18	+ .7	+ .2	40 33 58.27	+ 2 24.44	- 9	+ 13	+ 4	6	22.85	
	9		12.6013	27.3360	— 7	— .9	— .2	40 42 35.60	— 6 12.57	+ 22	- 17	—10	5	23.03	61.9
	IV 1	R	17.8257	20.0173	— 21	+ .7	+ .1	40 37 18.13	— 55.37	+ 3	+ 12	— 2	13	23.02	59.8
	2		20.8037	19.1683	0	−1.0	— .6	40 37 4.53	— 41.35	+ 2	— 23	— 2	11	23.06	
	3		29.1533	13.2840	+168	- 1.6	—1.1	40 29 41.67	+ 6 41.71	— 23	— 39	+12	7	22.95	59.9
	4		19.4473	25.2150	+117	1.0	.0	40 38 48.66	— 2 26.14	+ 8	— 16	— 5	10	22.49	
	5		28.2360	11.8993	+ 10	−1.2	— .4	40 29 28.86	+ 6 53.13	— 24	— 21	+12	6	21.69	59.8*a*
	6		11.2867[ii]	30.0170[iv]	— 6	+ .7	— .3	40 28 28.13	+ 7 53.61	+ 1.00	+ 7	+13	5	22.99	59.6
	7		26.8360	12.4320	— 47	-2.3	−1.8	40 30 18.91	+ 6 4.11	— 21	— 60	+ 10	6	22.37	
	9		22.6643	18.6537	+ 23	— .2	.0	40 38 4.52	— 1 41.47	+ 6	— 3	— 3	11	23.16	59.6
	10		25.9500	15.1663	+ 51	+1.4	+ .8	40 40 30.36	— 4 7.53	+ 14	+ 32	— 7	6	23.28	59.2
	11		33.7530[iv]	6.7013[ii]	+ 13	— .8	+ .5	40 24 57.69	+11 24.08	+ 88	— 6	+20	6	22.85	
Aug.	12		13.1020	25.7027	— 66	—1.3	—1.1	40 41 41.41	— 5 18.46	+ 19	— 35	— 10	7	22.76	59.3
3	III 1	R	29.9237	13.4807	+243	- .5	+1.4	40 43 18.79	— 6 56.40	+ 24	+ 10	—15	9	22.67	72.5
	2		7.5200[ii]	32.5503[iv]	+ 1	.0	.0	40 46 57.26	—10 32.94	— 91	0	25	11	23.27	71.9
	3		6.9917[ii]	31.3360[iv]	— 33	+2.6	+ .7	40 26 5.57	+10 15.50	+ 92	+ 50	+18	5	22.72	
	4	D	33.7027[iv]	9.5860[ii]	+ 59	+1.9	+ .5	40 26 11.40	+ 10 9.98	+ 92	+ 37	+19	6	22.92	71.0
	5		13.2980	24.1063	—123	— .6	—1.3	40 31 50.44	+ 4 33.00	— 16	— 26	+ 9	7	23.18	
	6		19.5040	14.9607	—109	+ .8	+1.5	40 38 16.99	— 1 54.61	+ 6	+ 32	- 3	6	22.79	
	7		20.7173	23.2473	+ 43	+ .4	+ .5	40 37 26.38	— 1 4.08	+ 4	+ 13	— 2	6	22.51	
	8		23.0063	17.3270	+ 7	+1.4	.0	40 33 59.13	- 2 23.63	— 9	+ 22	+ 4	6	22.99	
Aug.	9		25.1000	10.2850	—297	+1.3	+ .6	40 42 36.48	— 6 13.87	+ 22	+ 28	—10	5	23.06	70.4
5	III 1	D	11.5720	28.0480	— 26	— .2	+ .7	40 43 19.04	— 6 56.56	+ 24	+ 6	—15	9	22.72	75.4
	2		32.8703[iv]	7.8070[ii]	+ 16	+1.6	+2.4	40 46 57.55	—10 33.81	— 91	+ 56	—25	11	23.25	75.5
	3		33.8010[iv]	9.4620[ii]	+ 62	—1.5	— .4	40 26 5.74	+10 15.61	+ 92	— 29	+18	5	22.21	
	4	R	5.3937[ii]	29.5287[iv]	— 91	.0	— .1	40 26 11.78	+10 10.07	+ 92	— 1	+19	6	23.01	

1895.	Star.	P	Micrometer.	C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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Aug. 5	III 5	R	26.0707	15.3230	+ 64	— .7	—1.6	40 31 50.83	+ 4 31.94	— 16	— 31	+ 9	7 40 36 22.46	74.5
	6		18.2700	22.8403	+ 23	+1.6	+3.3	40 38 17.43	— 1 55.63	+ 6	+ 67	— 3	6 22.56	
Aug. 7	9		12.2580	27.0543	— 47	— .1	— .2	40 42 36.97	— 6 14.03	+ 22	— 4	—10	5 23.07	74.4
	III 1	R	28.8163	12.3570	+ 81	— .7	+ .8	40 43 19.29	— 6 56.41	+ 24	— 1	—15	9 23.05	75.5
	2		4.7937 ii	29.8560 iv	—118	— .3	+ .1	40 46 57.82	—10 38.45	— 91	— 3	—25	11 23.29	
	3		7.3830 ii	31.6967 iv	— 18	+2.1	+1.0	40 26 6.30	+10 14.77	+ 92	+ 46	+18	5 22.68	
	4		7.7350 ii	31.8370 iv	— 7	+ .8	+ .4	40 26 12.13	+10 9.44	+ 92	+ 18	+19	6 22.92	75.4
	5		27.6803	16.9713	+220	+ .3	+1.0	40 31 51.20	+ 4 31.35	— 16	+ 18	+ 9	7 22.73	75.4
	6		18.3697	22.9150	+ 25	—1.6	.0	40 38 17.85	— 1 55.00	+ 6	— 25	— 3	6 22.69	
	7		20.8353	18.2863	— 10	— .3	— .4	40 37 26.91	— 1 4.43	+ 4	— 10	— 2	6 22.46	
	8		17.4147	23.0640	+ 10	— .2	— .3	40 34 0.06	+ 2 22.88	— 9	— 7	+ 4	6 22.88	
	9		13.3140	28.1257	+ 92	— .2	+ .6	40 42 37.43	— 6 14.77	+ 22	+ 4	—10	5 22.87	74.7
	IV 1	D	19.7253	17.4857	— 27	+ .7	+ .4	40 37 20.00	— 56.56	+ 3	+ 16	— 2	13 23.74	72.4
	2		17.1910	18.9167	— 30	—1.5	— .9	40 37 6.48	— 43.56	+ 2	— 35	— 2	11 22.68	
	3		11.8960	27.6907	— 27	— .5	— .1	40 29 44.01	+ 6 39.33	— 23	— 9	+12	7 23.21	71.4
	4		20.7207	14.8597	—112	+ .2	— .6	40 38 50.67	— 2 27.92	+ 8	— 4	— 5	10 22.84	
	5		12.4693	28.7410	+ 84	—1.6	—1.4	40 29 31.39	+ 6 51.67	— 24	— 43	+12	6 22.57	
	6		29.9550 iv	11.3153 ii	— 6	—1.4	— .5	40 28 30.37	+ 7 51.32	+1.00	— 29	+13	5 22.58	70.4
	7		14.4637	28.7243	+198	+1.8	+1.1	40 30 21.14	+ 6 1.10	— 21	+ 43	+10	6 22.62	
	9		16.4807	20.5760	— 53	—1.4	+1.8	40 38 6.43	— 1 43.42	+ 6	0	— 3	11 23.15	69.7
Aug. 8	III 1	D	11.4463	27.9533	— 45	+1.6	+3.1	40 43 19.43	— 6 57.29	+ 24	+ 65	—15	9 22.97	74.4
	2		33.7603 iv	8.6987 ii	+ 55	+ .9	+ .9	40 46 57.97	—10 33 87	— 91	+ 26	—25	11 23.31	73.6
	3		33.1600 iv	8.8633 ii	+ 39	— .1	— .1	40 26 6.49	+10 14.48	+ 92	— 3	+18	5 22.09	
	4		33.8323 iv	9.7300 ii	+ 64	— .1	— .8	40 26 12.32	+10 9.63	+ 92	— 11	+19	6 23.01	
	5		13.4863	24.2260	—108	— .5	+1.1	40 31 51.39	+ 4 31.30	— 16	+ 6	+ 9	7 22.75	72.8
	6		21.7827	17.2353	— 20	.0	— .6	40 38 18.06	— 1 54.94	+ 6	— 7	— 3	6 23.14	72.5
	7		18.2730	20.8177	— 10	+ .1	.0	40 37 27.13	— 1 4.32	+ 4	+ 1	— 2	6 22.90	
	8		21.6503	16.0040	— 59	.0	— .1	40 34 0.29	+ 2 22.63	— 9	— 1	+ 4	6 22.92	
Aug. 10	9		25.1300	10.2870	—297	.0	— .9	40 42 37.67	— 6 14.58	+ 22	— 14	—10	5 23.12	71.9
	III 1	R	28.9383	12.4570	+ 99	+ .1	+ .2	40 43 19.76	— 6 57.01	+ 24	+ 4	—15	9 22.97	79.2
	2		6.4233 ii	31.4837 iv	— 49	— .9	— .6	40 46 58.32	—10 33.57	— 91	— 22	—25	11 23.48	78.6
	3		6.6493 ii	30.9437 iv	— 47	+1.0	+1.4	40 26 6.91	+10 14.21	+ 92	+ 34	+18	5 22.61	
	4		5.6637 ii	29.7527 iv	— 83	+ .3	+ .3	40 26 12.75	+10 8.92	+ 92	+ 9	+19	6 22.93	78.4
	5		27.3627	16.6543	+187	—1.2	— .8	40 31 51.83	+ 4 31.25	— 16	— 29	+ 9	7 22.79	78.4
	6		18.0507	22.6357	+ 14	— .8	+ .1	40 38 18.55	— 1 55.98	+ 6	— 11	— 3	6 22.55	
	7		21.4327	18.8587	— 1	+ .1	— .7	40 37 27.63	— 1 5.09	+ 4	— 7	— 2	6 22.55	78.1
	8		16.2580	21.8897	— 46	— .7	+1.2	40 34 0.81	+ 2 22.29	— 9	+ 4	+ 4	6 23.15	
	9		13.1953	28.0190	+ 78	—1.7	— .2	40 42 38.19	— 6 15.04	+ 22	— 30	—10	5 23.02	78.0
	IV 1	R	22.0053	24.2823	+ 65	+ .8	+ .1	40 37 20.72	— 57.74	+ 3	+ 14	— 2	13 23.26	75.8
	2		21.4317	19.7007	+ 7	—2.3	—1.2	40 37 7.24	— 43.79	+ 2	— 52	— 2	11 23.04	
	3		29.5997	13.8730	+240	— .6	— .7	40 29 44.64	+ 6 38.28	— 23	— 18	+12	7 22.70	75.3
	4		16.1543	22.0657	— 47	—1.1	+ .2	40 38 51.94	— 2 29.36	+ 8	— 15	— 5	10 22.06	*d*
	5		27.0440	10.8070	—154	.0	—1.5	40 29 32.24	+ 6 50.19	— 24	— 19	+12	6 22.18	
	6		11.1263 ii	29.7127 iv	— 4	+1.5	.0	40 28 31.23	+ 7 49.98	+1.00	+ 24	+13	5 22.63	74.8
	7		28.0523	13.7860	+113	—1.0	—1.8	40 30 21.99	+ 6 1.03	— 21	— 39	+10	6 22.58	
	8		11.0993	27.8903	— 73	— .6	.0	40 43 27.38	— 7 4.41	+ 24	— 9	—13	7 23.06	74.5*d*
	9		21.5877	17.4640	— 19	— .5	—1.4	40 38 7.13	— 1 44.22	+ 6	— 26	— 3	11 22.79	74.5*d*
	10		24.8980	14.9930	— 4	+1.6	+ .5	40 40 33.31	— 4 10.46	+ 14	+ 32	— 7	6 23.30	
	11		33.6720 iv	6.7197 ii	+ 11	— .7	—1.0	40 25 0.54	+11 21.56	+ 88	— 24	+20	6 23.00	*d*
	12		13.1563	25.8540	— 55	— .3	—1.2	40 41 44.18	— 5 20.94	+ 19	— 20	—10	7 23.20	74.4
Aug. 12	III 1	D	14.2027	30.6710	+350	— .7	— .3	40 43 20.12	— 6 57.31	+ 24	— 15	—15	9 22.84	77.0
	2		32.8140 iv	7.7263 ii	+ 12	—1.5	— .2	40 46 58.70	—10 34.42	— 91	— 26	—25	11 22.97	76.8
	3		33.1803 iv	8.8807 ii	+ 40	—1.7	—1.6	40 26 7.38	+10 14.56	+ 92	— 48	+18	5 22.61	
	4		32.1783 iv	8.0790 ii	+ 4	—1.1	—1.2	40 26 13.22	+10 9.40	+ 92	— 33	+19	6 23.46	
	5		13.1023	23.8073	—144	— .1	+2.2	40 31 52.32	+ 4 30.33	— 16	+ 26	+ 9	7 22.91	77.0

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
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Aug 12	III 6	D	21.9780	17 3827	— 14	— .1	— .6	40 38 19.08	— 1 56.16	+ 6	— 9	— 3	6	40 36 22.92	76.6
	7		18.5497	21.1653	— 5	— .6	— .1	40 37 28.18	— 1 6.13	+ 4	— 11	— 2	6	22.02	
	8		21.0697	15.4613	— 87	—1.0	+1.0	40 34 1.38	+ 2 21.60	— 9	+ 29	+ 4	6	23.28	
Aug 13	9		24.7990	9.9007	—344	+1.0	.1	40 42 38.77	— 6 15.86	+ 22	+ 17	—10	5	23.25	75.6
	IV 1	D	19.4770	17.1497	— 39	— .7	— .8	40 37 21.58	— 58.76	+ 3	— 21	— 2	13	22.75	68.5
	2		20.0347	21.8340	+ 14	— .1	.0	40 37 8.13	— 45.53	+ 2	— 1	— 2	11	22.70	
	3		11.8597	27.5823	— 38	+ .3	— .9	40 29 45.61	+ 6 37.48	— 23	— 6	+12	7	22.99	
	4		21.5277	15.5817	— 77	— .8	— .5	40 38 52.35	— 2 30.16	+ 8	+ 19	— 5	10	22.13	68.5
	5		11.9973	28.1790	+ 14	+1.4	—1.4	40 29 33.25	+ 6 49.22	— 24	— 40	+12	6	22.01	
	6		28.0867[iv]	9.5210[ii]	+ 14	— .8	— .5	40 28 32.22	+ 7 49.50	+1.00	— 19	+13	5	22.71	68.4
	7		14.8207	29.0080	—236	1.9	.8	40 30 22.97	+ 5 59.35	— 21	+ 40	+10	6	22.67	
	8		27.2013	10.3590	— 181	+1.8	1.3	40 43 28.32	— 7 5.43	+ 24	+ 45	—13	7	23.52	68.0
	9		18.5953	22.7470	+ 24	— .2	.0	40 38 8.01	— 1 45.04	+ 6	— 3	— 3	11	23.08	
	10		16.7130	26.6083	+ 142	—2.2	— .1	40 40 34.24	— 4 10.58	+ 14	— 37	— 7	6	23.42	67.0
	11		6.1177[ii]	33.0333[iv]	— 27	— .1	+ .1	40 25 1.44	+11 20.54	+ 88	0	+20	6	23.12	66.9
Aug 15	12		25.2137	12.4527	—131	1.9	.5	40 41 45.05	— 5 22.35	+ 19	+ 37	—10	7	23.23	
	III 1	R	28.4553	11.9600	+ 30	— .3	— .3	40 43 20.58	— 6 57.19	+ 24	— 9	—15	9	23.48	76.1
	2		6.1167[ii]	31.2223[iv]	— 62	—1.1	— .8	40 46 59.23	—10 34.68	— 91	— 27	—25	11	23.23	75.4
	3		7.7103[ii]	31.9690[iv]	— 6	+ .7	+ .2	40 26 8.02	+10 13.41	+ 92	+ 13	+18	5	22.71	
	4		3.6330[ii]	27.6930[iv]	—157	— .8	— .6	40 26 13.88	+10 8.00	+ 92	— 20	+19	6	22.85	74.4
	5		25.8967	15.2267	+ 51	—1.7	— .5	40 31 53.01	+ 4 29.94	— 16	— 34	+ 9	7	22.61	
	6		18.5977	23.2103	+ 36	—1.3	— .5	40 38 19.84	— 1 56.73	+ 6	— 27	— 3	6	22.93	
	7		20.5060	17.8647	— 18	— .3	— .7	40 37 28.99	— 1 6.74	+ 4	— 14	— 2	6	22.19	
	8		15.8290	21.3927	— 69	— .8	.0	40 34 2.21	+ 2 20.51	— 9	— 13	+ 4	6	22.60	
	9		12.1867	27.0753	— 49	—2.0	— .6	40 42 39.63	— 6 16.36	+ 22	— 39	—10	5	23.05	74.5
	IV 1	R	18.0510	20.3873	— 14	— .8	— .8	40 37 22.18	— 59.04	+ 3	— 23	— 2	13	23.05	72.4
	2		22.5847	20.7913	+ 27	—2.0	—1.4	40 37 8.76	— 45.43	+ 2	— 50	— 2	11	22.94	
	3		28.4610	12.8153	+ 86	— .1	+ .9	40 29 46.30	+ 6 35.85	— 23	+ 10	+12	7	22.21	
	4		18.2380	24.2023	+ 64	+ .5	+2.5	40 38 53.00	— 2 30.98	+ 8	+ 40	— 5	10	22.55	71.6
	5		29.9307	13.7960	+261	+ .2	+ .1	40 29 33.96	+ 6 48.65	— 24	+ 4	+12	6	22.59	
	6		10.8867[ii]	29.3997[iv]	— 2	+2.2	+2.3	40 28 32.94	+ 7 48.13	+1.00	+ 65	+13	5	22.90	71.3
	7		27.7677	13.5973	+ 83	— .8	— .2	40 30 23.69	+ 5 58.53	— 21	— 15	+10	6	22.02	
	9		20.8853	16.7020	— 45	+ .9	+ .7	40 38 8.59	— 1 45.67	+ 6	+ 23	— 3	11	23.29	71.4
	10		24.8310	14.8570	— 18	+1.3	+ .2	40 40 34.92	— 4 12.18	+ 14	+ 23	— 7	6	23.10	
	11		35.6133[iv]	8.7593[ii]	+130	— .8	— .1	40 25 2.09	+11 19.38	+ 88	— 14	+20	6	22.47	
Aug 18	12		12.7653	25.5480	— 94	— .5	— .7	40 41 45.69	— 5 23.00	+ 19	— 17	—10	7	22.68	71.4
	III 1	D	11.9913[ii]	28.4920[iv]	— 7	+1.4	+1.3	40 43 20.86	— 6 57.23	—1.04	+ 39	—15	9	22.92	71.4
	2		31.8417[iv]	6.7007[ii]	— 34	— .2	+ .1	40 46 59.57	—10 35.65	— 91	— 1	—25	11	22.86	
	3		33.6667[iv]	9.4270[ii]	+ 59	—1.9	—1.5	40 26 8.49	+10 13.09	+ 92	— 49	+18	5	22.24	
	4		33.3410[iv]	9.3047[ii]	+ 47	—1.2	—1.3	40 26 14.35	+10 7.92	+ 92	— 36	+19	6	23.08	
	5		13.7880	24.4433	— 81	+ .2	— .1	40 31 53.52	+ 4 29.23	— 16	+ 1	+ 9	7	22.76	70.4
	6		22.5067	17.8500	+ 8	+ .9	.0	40 38 20.44	— 1 57.77	+ 6	+ 14	— 3	6	22.90	
	7		19.0150	21.6850	+ 8	+1.4	+1.8	40 37 29.62	— 1 7.54	+ 4	+ 45	— 2	6	22.61	70.4
	8		22.9807	17.4383	+ 9	— .4	— .7	40 34 2.88	+ 2 20.17	— 9	— 15	+ 4	6	22.91	70.4
	9		26.2887	11.3727	—150	—1.5	—1.9	40 42 40.33	— 6 16.80	+ 22	— 48	—10	5	23.22	69.5
	IV 1	D	20.2373	17.8823	— 18	—2.5	—2.7	40 37 22.99	— 59.50	+ 3	— 74	— 2	13	22.89	68.4
	2		19.2723	21.1053	+ 1	—2.7	—1.0	40 37 9.61	— 46.35	+ 2	— 56	— 2	11	22.81	
	3		11.6557	27.3177	— 67	+ .5	+ .5	40 29 47.24	+ 6 35.86	— 23	+ 14	+12	7	23.20	68.5
	4		22.2330	16.2140	— 43	+1.4	+ .1	40 38 53.89	— 2 32.09	+ 8	+ 24	— 5	10	22.17	
	5		12.0270	28.1423	+ 11	.0	— .4	40 29 34.93	+ 6 47.53	— 24	— 5	+12	6	22.35	67.5
Aug 19	III 2	R	7.2353[ii]	32.3397[iv]	— 10	— .1	—1.1	40 46 59.66	—10 34.78	— 91	— 15	—25	11	23.68	65.4
	3		7.2517[ii]	31.4773[iv]	— 24	+2.3	+1.4	40 26 8.62	+10 12.53	+ 92	+ 55	+18	5	22.85	
	4		7.7633[ii]	31.7823[iv]	— 8	—1.0	.0	40 26 14.49	+10 7.34	+ 92	— 16	+19	6	22.84	
	5		27.4970	16.8803	+202	+ .4	— .1	40 31 53.66	+ 4 28.97	— 16	+ 5	+ 9	7	22.68	65.9
	6		18.7563	23.4127	+ 45	—1.1	— .4	40 38 20.61	— 1 57.86	+ 6	— 22	— 3	6	22.62	

1895.	Star.	P	Micrometer.		C	Levels. A	Levels. B	½(δ + δ′)	Corrections. Micrometer.	Corrections. δ	Corrections. l	Corrections. r	Corrections. Mer	Latitude.	Thermom.
Aug								° ′ ″						° ′ ″	°
19	III 7	R	19.2623	16.6047	— 49	+1.2	— .4	40 37 29.79	— 1 7.08	+ 4	+ 14	— 2	6	40 36 22.93	64.8
	8		18.3123	23.8263	+ 51	— .6	— .1	40 34 3.08	+ 2 19.56	— 9	— 11	+ 4	6	22.54	64.8
	9		13.8397	28.7437	+168	—1.2	—1.2	40 42 40.53	— 6 17.30	+ 22	— 35	—10	5	23.05	65.0
	IV 1	R	19.5483	21.9500	+ 15	+2.1	+ .7	40 37 23.23	— 1 0.77	+ 3	+ 43	— 2	13	23.03	62.0
	2		22.3017	20.4440	+ 21	— .1	+ .7	40 37 9.86	— 47.03	+ 2	+ 7	— 2	11	23.01	
	3		29.1583	13.5593	+184	— .0	— .5	40 29 47.52	+ 6 34.91	— 23	— 6	+12	7	22.33	61.5
	4		18.8640	24.8460	+ 98	—1.3	— .5	40 38 54.16	— 2 31.51	+ 8	— 27	— 5	10	22.51	
	5		28.2740	12.1780	+ 24	— .3	+ .1	40 29 35.25	+ 6 47.10	— 24	— 3	+12	6	22.26	
	6	D	29.4143iv	10.9210ii	— 2	—1.1	—1.0	40 28 34.25	+ 7 47.63	+1.00	— 30	+13	5	22.76	62.1
	7		13.8157	27.9407	+108	+ .9	— .3	40 30 25.00	+ 5 57.45	— 21	+ 10	+10	6	22.50	
	8		33.7157	16.8823	+771	+1.4	+ .5	40 43 30.29	— 7 7.61	+ 24	+ 29	—13	7	23.15	
	9		14.8993	19.1410	—109	— .4	+1.7	40 38 9.74	— 1 46.98	+ 6	+ 16	— 3	11	23.06	
	10		15.5310	25.5287	+ 43	— .8	+ .2	40 40 36.23	— 4 12.92	+ 14	— 10	— 7	6	23.34	59.8
	11		5.6850ii	32.4977iv	— 55	+1.0	+ .3	40 25 3.38	+11 17.87	+ 88	+ 20	+20	6	22.59	59.3

Adjustment of the Latitude.

In case every pair of a given group has been observed on any night, the mean of the resulting latitudes will be based upon the mean value of the declinations of all stars of this group. The differences between the individual values and the mean of all will furnish the corrections required to reduce the individual latitudes to the mean system. These corrections will only be required in case of failure to observe one or more of the pairs forming the group.

In order to avoid errors resulting from outstanding uncertainties as to the value of the micrometer screw, it is desirable that the plus and minus corrections of each group shall balance as nearly as may be. This condition cannot be fully realized, at least not for any considerable time, owing to the effect of precession. The following tabular statement gives the approximate values of these corrections, in terms of micrometer revolutions, for each group of this series.

	Beginning. I	Beginning. II	Beginning. III	Beginning. IV	End. I	End. II	End. III	End. IV
Pair . 1	—15.3	— 6.4	—15.8	— 1.3	—15.4	— 6.4	—16.4	— 2.1
2	+ 4.2	— 5.1	—24.4	— 0.7	+ 4.0	— 5.1	—25.0	— 1.6
3	—14.2	+ 2.5	+25.2	[+16.8]	—14.4	+ 2.5	+24.4	[+15.9]
4	— 3.5	— 2.1	+25.0	— 4.8	— 3.6	— 2.1	+24.2	— 5.7
5	+ 8.3	— 0.3	+11.7	+17.4	+ 8.3	— 0.3	+10.9	+16.4
6	+ 6.7	—22.9	— 3.5	+19.8	+ 6.8	—22.9	— 4.4	+18.8
7	—16.1	[—11.7]	— 1.4	+15.4	—16.1	[—11.7]	— 2.4	+14.4
8	+ 6.4	+20.9	+ 6.8	—15.6	+ 6.5	+20.8	+ 5.8	—16.6
9	— 5.3	[+ 3.5]	—13.6	— 3.0	— 5.2	[+ 3.5]	—14.7	— 4.0
10	+21.4	+16.0		— 8.7	+21.6	+15.9		— 9.8
11				[+28.1]				[+27.1]
12				—11.5				—12.6
Mean . . .	—0.7	— 0.6	+ 1.1	+ 4.3	— 0.7	— 1.0	+ 0.3	+ 3.3
Omitting brackets		+ 0.3		+ 0.4		+ .3		— 0.1

By omitting the bracketed pairs in Groups II and IV the algebraic sum of the corrections is in every case so small that very little apprehension need exist with respect to errors from this source. The latitudes have therefore been reduced to the means of the remaining pairs of these groups. One of the component stars of Pair 9, Group II, is a variable which was lost on so many occasions that this pair was not included.

The following tabular statements show the individual differences from the mean values, with the resulting reductions for the separate pairs.

I.

1894.	1	2	3	4	5	6	7	8	9	10
Jan. 19	+ 3	+ 59	— 56	— 5	— 58	+ 22	— 55	+ 31	+ 52	+ 02
25	— 8	+ 19	+ 3	— 71	+ 3	+ 29	— 16	— 19	+ 35	+ 24
27	+ 9	+ 13	— 21	+ 16	— 28	+ 2	— 44	+ 19	— 6	+ 85
30	— 2	+ 42	— 7	+ 2	+ 47	+ 17	— 12	— 24	— 8	— 51
Feb. 6	+ 25	+1.15	+ 5	— 63	+ 4	— 89	— 29	— 8	+ 43	+ 3
23	+ 19	+ 38	— 11	+ 6	+ 63	— 49	— 31	+ 9	— 26	— 19
24	— 4	+ 8	+ 23	— 24	— 70	— 18	— 8	+ 38	+ 23	+ 36
27	— 46	+ 60	+ 19	— 31	— 12	+ 10	— 24	+ 15	+ 19	— 9
Mar. 3	— 16	+ 41	— 65	— 25	+ 12	— 7	— 17	+ 9	+ 25	+ 47
4	+ 16	+ 70	— 12	— 14	+ 29	— 52	+ 15	— 28	— 11	— 13
7	+ 38	+ 31	+ 9	— 42	— 49	— 8	— 25	— 26	+ 31	+ 39
12	+ 20	+ 17	— 21	— 18	+ 14	— 30	— 20	+ 19	+ 29	— 10
14	+ 13	+ 21	— 7	— 39	+ 38	+ 9	— 33	— 13	+ 21	— 11
Oct. 11	— 44	+ 11	+ 78	+ 91	— 16	— 61	— 13	— 39	+ 6	— 10
17	— 28	+ 30	+ 8	— 22	— 14	— 13	+ 9	— 38	+ 15	+ 48
18	+ 12	+ 30	+ 13	+ 42	— 58	— 27	— 7	+ 12	+ 39	— 52
19	+ 11	+ 52	+ 29	— 47	+ 22	— 52	+ 33	— 86	+ 58	— 24
27	+ 30	+ 65	— 40	+ 19	— 26	— 27	— 18	— 11	+ 40	— 38
31	— 19	+ 14	+ 23	— 33	— 30	+ 16	— 32	— 44	+ 79	+ 26
Nov. 1	— 30	+ 50	— 25	+ 1	— 42	+ 11	— 25	— 3	+ 65	+ 3
3	— 13	+ 12	+ 29	— 13	— 5	— 6	— 46	— 12	+ 35	+ 18
10	— 0	— 12	+ 27	— 34	+ 29	— 24	— 46	+ 36	+ 17	+ 2
11	— 14	+ 32	— 8	— 11	— 52	+ 4	— 5	— 22	+ 34	+ 40
19	— 2	+ 31	+ 5	— 16	+ 5	— 35	— 10	— 54	+ 40	+ 40
Dec. 3	— 16	+ 54	— 22	+ 12	— 54	+ 23	— 56	+ 6	+ 48	+ 3
4	— 16	+ 17	+ 56	— 44	+ 13	— 13	— 24	— 44	+ 76	— 17
5	+ 19	+ 35	— 8	+ 34	— 32	— 16	— 53	+ 20	+ 21	— 19
23	— 2	+ 38	— 13	+ 6	+ 6	+ 7	— 87	+ 12	+ 86	— 52
27	+ 41	— 17	— 13	— 56	+ 43	+ 21	+ 14	— 70	— 21	+ 62
1895. 31	+ 4	— 32	+ 51	— 54	+ 2	— 26	— 34	+ 16	+ 60	+ 12
Jan. 1	+ 29	+1.06	— 1	— 48	— 89	— 34	— 92	+ 32	+ 89	+ 8
4	+ 11	+ 43	+ 4	— 32	— 79	— 93	— 38	+ 47	+1.04	+ 32
11	+ 13	+ 6	— 16	+ 15	— 23	— 9	+ 8	— 9	+ 18	— 1
16	— 7	+ 21	+ 23	+ 37	— 50	— 31	— 60	+ 38	+ 4	+ 21
19	+ 18	+ 42	+ 45	— 6	+ 11	— 58	+ 16	— 21	— 47	+ 4
23	+ 22	— 16	— 51	+ 32	— 27	— 13	— 52	+ 53	+ 30	+ 18
24	— 42	+ 14	+ 17	— 32	+ 18	— 27	— 32	— 13	+ 59	+ 37
27	+ 55	+ 4	— 3	— 56	— 5	— 25	— 41	+ 62	+ 8	+ 3
31	+ 5	+ 28	+ 7	— 60	— 11	— 18	— 28	+ 16	+ 54	+ 7
Feb. 2	+ 7	— 12	— 8	— 10	— 26	— 1	— 28	— 23	+ 92	+ 9
Mar 3	+ 10	+ 13	+ 81	— 75	+ 4	— 45	— 23	— 18	+ 5	+ 45
9	+ 16	+ 58	— 41	+ 11	— 23	— 1	— 64	+ 18	— 30	+ 57
Mean .	+ 03	+ 30	+ 02	— 16	— 13	— 17	— 27	— 03	+ 32	+ 09

II.

1894.	1	2	3	4	5	6	7	8	9	10
Feb. 1	+ 14	— 20	+ 3	+ 13	— 18	+ 34	— *28*	— 41		+ 15
16	— 38	+ 68	+ 15	— 57	— 6	+ 22	+ *31*	— 2		+ 1
24	+ 6	+ 77	+ 7	— 7	+ 45	— 38	— *20*	— 69		— 23
26	— 13	— 24	+ 6	— 98	— 37	— 28	— *22*	+ 37		— 37
Mar. 4	— 22	+ 35	+ 4	+ 49	+ 12	— 15	+ *60*	— 46		— 14
14	— 36	+ 33	— 4	+ 49	+ 14	— 6	+ *74*	— 29	— *18*	— 17
16	— 24	— 59	+ 30	+ 31	— 12	+ 32	+ *04*	— 25	— *46*	+ 12
April 13	— 29	— 39	+ 3	+ 26	+ 18	+ 1	— *22*	— 3	— *14*	+ 19
14	— 19	— 3	+ 28	+ 42	+ 17	— 97	+ *69*	+ 25	— *53*	+ 10
15	+ 15	— 35	— 11	+ 63	— 7	— 45	— *13*	+ 26	— *15*	— 6
22	+ 2	— 20	+ 40	+ 59	+ 29	— 69	+ *31*	— 53	+ *8*	+ 9
24	+ 8	— 20	— 14	+ 26	— 3	— 6	— *41*	+ 13	— *4*	— 7
25	— 29	— 36	+ 52	+ 61	+ 76	— 53	+ *76*	— 56	— *28*	— 13
26	— 32	+ 26	— 24	+ 42	+ 13	+ 9	+ *4*	— 44	— *2*	+ 10
May 8	— 40	+ 26	— 0	+ 43	+ 20	— 52	+ *44*	— 21	— *39*	+ 21
9	— 2	— 70	+ 27	+ 57	+ 27	+ 39	+ *12*	— 61	— *62*	— 20
12	+ 4	— 19	+ 11	+ 61	+ 22	— 72	— *16*	— 28	— *24*	+ 18
26	— 16	— 12	+ 23	+ 38	— 8	— 23	+ *23*	— 25	— *33*	+ 26
June 10	— 32	— 8	+ 3	+ 42	+ 46	— 5	— *8*	— 58	— *96*	+ 18
14	— 11	+ 13	+ 12	+ 36	+ 54	— 64	+ *46*	— 16		— 26
15	— 24	+ 16	+ 15	+ 97	+ 16	— 15	— *3*	— 85	— *30*	— 17
17	+ 10	— 5	— 3	+ 43	+ 33	— 24	+ *38*	— 1		— 51
1895. 22	+ 30	— 35	— 17	+ 21	+ 68	— 27	+ *13*	— 59		+ 17
Mar. 16	+ 59	— 17	— 21	+ 14	— 10	— 45	+ *33*	— 8	— *12*	+ 20
17	— 20	— 39	+ 34	+ 20	+ 68	— 7	+ *60*	— 57	— *51*	+ 2
21	+ 24	— 32	— 9	+ 39	+ 17	+ 3	+ *6*	— 22	— *30*	— 19
25	— 10	+ 19	+ 82	— 21	— 6	— 20	+ *29*	— 38	— *52*	+ 42
28	— 2	— 4	— 10	+ 64	+ 32	— 23	— *30*	— 33	— *77*	— 22
April 10	+ 27	— 28	+ 18	+ 37	+ 7	— 48	+ *17*	— 11	— *8*	— 2
11	— 1	— 57	— 16	+ 44	+ 31	— 14	— *33*	+ 16	— *27*	— 3
14	— 25	— 3	+ 13	+ 5	+ 43	— 31	— *11*	— 35	— *74*	+ 35
18	— 0	— 30	— 26	+ 85	— 30	— 50	+ *9*	— 22	— *7*	+ 69
19	— 2	+ 46	— 58	+ 22	— 11	+ 11	+ *37*	— 33	— *32*	+ 26
20	— 1	+ 11	— 40	+ 14	— 37	— 12	+ *51*	+ 34	— *42*	+ 28
21	+ 15	— 16	— 12	+ 29	+ 7	— 55	+ *1.03*	— 13	— *15*	+ 41
23	+ 8	— 7	— 19	+ 72	+ 7	— 59	— *29*	— 51	— *85*	+ 47
May 1	— 41	+ 43	+ 13	+ 69	— 10	— 41	— *8*	— 19	— *49*	+ 20
6	— 46	+ 12	— 5	+ 49	+ 49	— 37	+ *82*	— 33	— *45*	+ 9
9	+ 11	— 25	— 5	+ 52	+ 35	— 17	+ *31*	— 51	— *59*	— 4
16	— 88	+ 82	— 36	+ 65	+ 28	— 40	+ *6*	— 52	— *29*	+ 38
18	+ 7	— 23	— 3	+ 29	+ 31	— 24	+ *59*	— 43	— *44*	+ 27
22	— 43	— 20	+ 48	+ 24	— 13	— 3	— *23*	— 5	— *77*	+ 18
23	+ 36	— 44	— 25	+ 22	+ 45	— 18	+ *39*	— 30	— *8*	+ 13
28	+ 17	— 14	— 25	+ 15	+ 42	— 24	— *17*	— 30	— *82*	+ 21
29	+ 19	— 33	+ 14	+ 25	+ 49	— 38	+ *3*	— 4	— *69*	— 30
30	— 48	— 4	— 19	+ 29	+ 59	— 22	— *10*	— 6	— *65*	+ 13
June 7	— 41	+ 8	+ 39	+ 33	+ 41	— 22	+ *60*	— 38	— *29*	— 18
8	— 22	— 5	+ 8	+ 48	+ 40	+ 2	+ *18*	— 62	— *90*	— 8
9	+ 6	— 37	— 9	+ 58	+ 1	— 19	+ *26*	— 62	+ *12*	+ 63
11	— 20	+ 22	— 1	— 4	+ 35	— 17	+ *27*	— 51	— *52*	+ 32
14	+ 28	+ 5	+ 23	+ 31	+ 20	— 40	+ *41*	— 52		— 18
23	— 14	— 2	+ 9	+ 30	— 0	— 20	+ *31*	+ 8	— *66*	— 14
Mean .	— 09	— 06	+ 02	+ 37	+ 20	— 24	+ *18*	— 27	— *40*	+ 07

III.

1894.	1	2	3	4	5	6	7	8	9
May 8	— 4	— 22	— 41	— 32	+ 37	+ 37	+ 33	— 24	+ 19
12	— 0	— 35	+ 24	— 11	+ 13	— 17	+ 58	+ 29	— 63
26	— 10	— 50	— 13	— 40	+ 26	+ 22	+ 23	+ 74	— 32
27	— 11	— 33	+ 61	— 85	+ 7	— 10	+ 66	+ 51	— 47
June 10	+ 12	— 48	— 8	— 50	+ 2	+ 12	+ 22	+ 42	+ 18
15	— 15	— 35	— 5	— 87	+ 63	— 9	— 1	+ 37	+ 49
28	— 3	— 11	— 16	— 22	+ 25	— 0	+ 11	+ 21	— 3
July 9	+ 26	+ 19	+ 3	— 53	— 4	+ 0	+ 22	+ 18	— 27
12	+ 2	— 24	— 42	— 31	+ 39	+ 26	+ 30	— 14	+ 14
13	— 37	+ 3	+ 6	— 93	+ 26	+ 9	+ 20	+ 87	+ 24
17	— 22	— 32	— 0	— 33	+ 48	+ 22	+ 12	— 16	+ 17
25	— 8	— 62	+ 47	— 12	+ 13	+ 5	— 22	+ 61	— 24
Aug. 5	+ 65	— 51	— 25	— 31	— 9	+ 20	+ 10	— 3	+ 26
6	+ 24	+ 4	— 64	— 49	+ 2	+ 18	+ 43	— 12	+ 32
9	+ 51	+ 7	— 24	— 97	+ 30	+ 35	+ 25	— 19	— 9
10	+ 14	+ 45	— 73	— 85	+ 21	+ 27	+ 27	+ 6	+ 16
21	+ 31	+ 41	— 80	— 12	+ 1	+ 7	— 33	+ 13	+ 30
22	— 2	+ 59	+ 25	—1.04	— 5	+ 15	+ 32	— 5	— 16
23	+ 28	— 20	— 48	— 82	+ 35	+ 54	+ 25	— 31	+ 40
24	+ 44	+ 18	+ 21	— 79	— 39	+ 6	+ 45	— 20	+ 7
31	+ 26	— 1	— 29	— 35	+ 17	+ 3	— 4	— 4	+ 24
Sept. 11	— 1	— 34	— 49	— 70	+ 2	— 0	+ 28	+ 27	+ 30
Mean .	+ 09	— 09	— 15	— 54	+ 16	+ 13	+ 21	+ 15	+ 04

III.

1895.	1	2	3	4	5	6	7	8	9
May 9	— 5	— 57	+ 19	— 45	+ 28	— 16	+ 23	+ 36	+ 20
10	— 10	— 35	+ 35	— 60	— 5	+ 32	+ 34	+ 52	— 42
22	— 9	— 22	— 8	— 68	+ 9	+ 40	+ 51	— 17	+ 20
23	+ 20	— 29	+ 61	— 21	+ 8	+ 2	— 3	— 28	— 11
28	— 22	— 43	— 14	— 52	+ 28	+ 11	+ 34	+ 68	— 8
29	— 31	— 38	+ 43	— 51	— 6	+ 25	+ 41	+ 29	— 15
30	— 40	— 36	— 11	— 13	— 7	+ 23	+ 58	+ 24	— 24
June 7	+ 14	— 18	+ 51	— 19	+ 25	— 40	+ 51	— 29	— 37
8	— 26	— 34	— 7	— 55	+ 4	+ 49	+ 26	+ 69	— 30
11	— 31	— 16	— 34	— 46	+ 40	+ 59	+ 32	+ 42	— 49
25	+ 15	— 10	+ 54	— 78	— 27	+ 14	+ 84	— 11	— 38
July 9	— 54	— 23	+ 56	— 17	— 2	— 28	+ 46	+ 7	+ 16
10	— 42	— 39	— 6	— 1	+ 29	— 17	+ 77	+ 29	— 32
12	— 7	— 33	+ 42	— 9	— 30	— 5	+ 30	+ 33	— 19
18	— 21	— 8	+ 71	— 10	— 2	— 50	+ 29	+ 23	— 28
19	+ 26	— 22	— 2	— 80	+ 33	+ 8	+ 27	+ 16	— 4
25	— 5	+ 33	+ 49	— 51	+ 12	— 18	+ 25	— 7	— 37
28	— 21	— 36	+ 71	— 30	— 11	— 28	+ 44	+ 39	— 27
30	+ 8	— 50	+ 26	— 29	+ 12	— 2	+ 17	+ 3	+ 15
31	+ 6	— 15	+ 44	— 32	+ 50	— 8	— 4	— 12	— 30
Aug. 3	+ 23	— 37	+ 18	— 2	— 28	+ 11	+ 39	— 9	— 16
7	— 21	— 45	+ 16	— 8	+ 11	+ 15	+ 38	— 4	— 3
8	— 6	— 40	+ 82	— 10	+ 16	— 23	+ 1	— 1	— 21
10	— 8	— 59	+ 28	— 4	+ 10	+ 34	+ 34	— 26	— 13
12	+ 8	— 5	+ 31	— 54	+ 1	— 0	+ 90	— 36	— 33
15	— 63	— 38	+ 14	— 0	+ 24	— 8	+ 66	+ 25	— 20
18	— 9	— 3	+ 59	— 25	+ 7	— 7	+ 22	— 8	— 39
Mean .	— 11	— 28	+ 30	— 32	+ 9	+ 3	+ 37	+ 11	— 19

IV.

1894.	1	2	3	4	5	6	7	8	9	10	11	12
July 9	— 12	— 11	+ *9*	+ 34	— 35	— 34	+ 30	— 38	+ 51	— 34	— *52*	+ 50
12	+ 32	— 5	+ *37*	+ 77	+ 5	— 70	+ 64	— 32	— 19	— 30	+ *42*	— 22
13	— 19	+ 50	— *16*	+ 24	+ 11	— 19	+ 12	— 31	— 12	— 24	— *51*	+ 8
Aug. 5	— 37	+ 5	— *28*	+ 49	— 19	— 1	+ 9	— 32	— 25	— 8	— *76*	+ 50
6	— 14	— 8	— *18*	+ 31	+ 23	— 53	— 3	— 50	— 8	+ 22	— *61*	+ 58
9	— 80	+ 41	— *37*	+ 41	+ 2	— 14	+ 18	— 30	+ 7	— 4	— *45*	+ 21
20	— 14	+ 26	— *50*	+ 26	— 34	— 37	— 8	— 49	— 33	+ 58	—*1.12*	+ 63
22	— 2	— 12	— *3*	+ 57	+ 3	— 36	+ 18	— 31	+ 11	+ 9	— *38*	+ 19
23	+ 36	— 0	— *40*	+ 11	+ 8	— 27	+ 16	— 47	+ 15	— 40		+ 31
31	— 46	— 4	— *25*	+ 6	+ 53	+ 22	— 18	— 47	— 8	— 10	— *69*	+ 57
Sept. 11	— 27	+ 12	— *22*	+ 56	+ 12	+ 15	+ 29	— 99	— 1	— 24	— *22*	+ 23
12	+ 3	+ 41	— *3*	+ 29	+ 12	— 21	+ 18	— 76	+ 7	— 2	— *39*	— 8
15	— 8	+ 5	— *5*	+ 23	+ 31	— 26	+ 55	— 56	— 31	+ 1	— *16*	+ 11
Oct. 5	+ 12	+ 1	+ *4*	+ 67	+ 28	— 22	+ 27	— 12	— 14	— 58	— *23*	— 26
6	+ 9	+ 18	— *74*	+ 9	— 42	— 20	— 11	— 39	+ 27	+ 18	— *78*	+ 28
16	— 31	+ 3	+ *30*	+ 98	+ 46	— 46	+ 21	— 16	— 66	+ 13	— *30*	— 25
18	— 25	— 32	— *8*	+ 65	+ 16	— 67	+ 22	— 36	+ 15	+ 1	— *78*	+ 43
19	— 9	+ 31	— *27*	+ 53	— 15	+ 32	— 18	— 79	+ 12	— 31	— *54*	+ 26
20	— 54	+ 3	+ *3*	+ 52	+ 6	— 37	+ 6	+ 30	— 21	— 14	— *24*	+ 24
Nov. 1	+ 8	+ 47	— *9*	+ 39	+ 13	— 26	+ 3	— 41	— 10	— 37	— *16*	+ 8
4	— 32	— 5	+ *30*	+1.02	+ 4	— 20	+ 10	— 26	— 49	— 36	— *32*	+ 56
11	— 11	+ 16	— *20*	+ 19	— 0	+ 3	+ 14	— 48	+ 5	— 26	— *37*	+ 30
12	+ 11	+ 28	+ *38*	+ 74	+ 6	— 71	+ 53	— 22	— 45	— 54	+ *47*	+ 21
15	— 17	— 25	— *48*	+ 42	+ 3	+ 12	+ 1	— 35	— 1	+ 1	— *65*	+ 24
19	— 12	+ 10	— *72*	+ 3	+ 16	— 12	— 25	— 5	— 27	+ 60	— *17*	— 3
20	— 23	+ 5	+ *33*	+1.05	— 8	— 25	+ 40	— 29	+ 4	— 58	— *11*	— 10
21	— 66	+ 44	— *35*	+ 67	— 8	+ 7	+ 14	— 65	— 25	+ 10	— *16*	+ 22
22	— 50	— 3		+ 28	+ 17	— 30	+ 26	— 6	+ 6	— 29	— *62*	+ 37
26	— 31	— 6	— *54*	+ 45	+ 13	— 0	+ 6	— 29	+ 3	— 4	— *59*	+ 3
27	+ 13	— 16	— *20*	+ 66	+ 33	— 1	+ 48	— 3	—1.13	+ 2	— *66*	— 33
29	+ 50	— 26	— *16*	+ 45	+ 16	— 1	— 4	— 34	— 33	— 44	— *14*	+ 29
Mean .	— 14	+ 07	— *15*	+ 46	+ 07		+ 15	— 36	— 13	— 12	— *39*	+ 20

IV.

1895.	1	2	3	4	5	6	7	8	9	10	11	12
July 16	— 16	— 45	— *73*	+ 47	— 4	+ 32	+ 13	— 81	— 8	+ 2	— *18*	+ 57
18	— 44	— 1	+ *38*	+ 78	+ 27	— 15	+ 63	— 74	+ 6	— 31	— *25*	— 5
19	— 72	+ 64	— *66*	+ 39	+ 33	— 9	+ 14	— 58	— 24	+ 14	— *31*	— 1
28	+ 28	— 24	+ *34*	+ 33	+ 34	— 8	+ 96	— 66	— 12	— 41	+ *13*	— 44
29	+ 35	+ 1	— *6*	+ 26	+ 47	— 7	+ 13	— 39	— 18	+ 20	+ *50*	— 81
Aug. 10	— 45	— 23	+ *11*	+ 75	+ 63	+ 18	+ 23	— 25	+ 3	— 49	— *19*	— 39
13	+ 17	+ 22	— *7*	— 21	+ 91	+ 21	+ 25	+ 60	— 16	— 50	— *20*	— 31
Mean .	— 14	— 01	— *10*	+ 40	+ 42	+ 5	+ 35	— 57	— 10	— 19	— *07*	— 21

In the following tabular statement the column headed ϕ_1 gives the daily mean value of the seconds of latitude, the preceding corrections being applied when necessary. In column ϕ_2 the corrections for aberration and final adjustment of groups derived on pages 149 and 151 have been applied.

	I			II			III				II			III			IV			I		
	ϕ_1	ϕ_2	No	ϕ_1	ϕ_2	No	ϕ_1	ϕ_2	No		ϕ_1	ϕ_2	No	ϕ_1	ϕ_2	No	ϕ_1	ϕ_2	No	ϕ_1	ϕ_2	No
1894	//	//		//	//		//	//		1894	//	//		//	//		//	//		//	//	
Jan. 19	23.34	23.23	10							June 22	22.82	22.92	9	22.91	22.92	7						
25	22.79	22.67	10							27	22.86	22.97	8									
27	23.28	23.17	10	23.09	23.08	8				28	22.96	23.07	8	22.93	22.92	9						
28	23.34	23.22	7							July 3	22.78	22.89	7	22.93	22.92	8						
30	22.92	22.81	10							5	22.79	22.91	7	22.79	22.80	4						
31	23.38	23.26	9							9				23.11	23.11	9	22.88	22.91	12			
Feb. 1				23.35	23.34	9				10				22.68	22.70	5						
4				22.81	22.79	3				11				23.32	23.33	1						
5	23.30	23.20	9							12				22.81	22.82	9	22.95	23.00	12			
6	23.23	23.12	10							13				22.96	22.97	9	22.93	22.97	12			
11	23.17	23.06	9	23.07	23.06	2				17				22.96	22.98	9	22.86	22.92	4			
15	23.14	23.03	9							24				23.16	23.19	8	23.11	23.16	11			
16	23.28	23.18	7	23.35	23.34	9				25				23.23	23.26	9	23.01	23.08	11			
19	23.10	23.00	3							Aug. 5				22.92	22.95	9	23.04	23.10	12			
20	22.91	22.80	3							6				22.68	22.72	9	22.75	22.82	12			
23	23.05	22.95	10	22.95	22.94	8				9				22.93	22.97	9	22.60	22.67	12			
24	22.95	22.84	10	23.13	23.12	9				10				23.01	23.05	9	22.75	22.83	11			
26				23.35	23.34	9				20				22.95	23.00	7	22.77	22.85	12			
27	23.57	23.47	10							21				22.87	22.92	9						
Mar. 3	23.42	23.31	10	23.41	23.40	8				22				23.04	23.09	9	22.90	22.99	12			
4	23.32	23.22	10	23.27	23.26	9				23				22.96	23.01	9	22.84	22.92	11			
7	23.55	23.44	10							24				22.97	23.02	9	22.92	23.01	11			
8	23.20	23.09	7	23.20	23.19	3				31				22.92	22.98	9	22.92	23.01	12			
12	23.36	23.26	10							Sept. 7				22.91	22.97	8						
13				23.13	23.12	5				11				22.89	22.95	9	23.00	23.11	12			
14	23.25	23.14	10	23.20	23.19	10				12				22.99	23.06	8	22.85	22.95	12			
16	23.10	23.00	8	23.14	23.14	10				15				22.79	22.86	8	22.97	23.06	12			
17	23.31	23.20	8	23.38	23.38	3				Oct. 2							23.00	23.12	11			
18	23.22	23.12	8							5							22.99	23.12	12			
19				23.11	23.10	9				6							23.07	23.20	12	23.33	23.18	8
Apl. 6				23.56	23.58	1				11							23.16	23.30	5	23.16	23.00	10
7				22.99	23.00	9				15							23.04	23.17	11			
13				23.37	23.39	10				16							22.90	23.04	12	23.23	23.08	9
14				23.22	23.24	10				17							23.02	23.15	11	23.32	23.17	10
15				23.07	23 09	10				18							22.91	23.05	12	23.31	23.16	10
16				23.18	23.21	2				19							23.12	23.25	12	23.13	22.98	10
22				23.23	23.26	10				20							22.98	23.12	12			
24				22.97	23.00	10				27							23.11	23 24	11	23.25	23.10	10
25				23.08	23.11	10				31										23.24	23.09	10
26				23.19	23.22	10				Nov. 1							22.96	23.11	12	23.38	23.23	10
30				23.20	23.21	9				2							22.75	22.89	7			
May 8				23.04	23.08	10	23.17	23.10	9	3										23.30	23.14	10
9				22.82	22.87	10	23.07	23.00	8	4							23.07	23.22	12			
10				23.00	23.05	9	23.27	23.22	3	6										23.15	23.01	6
12				22.86	22.91	10	23.05	22.99	9	10										23.23	23.08	10
13				23.05	23.11	4				11							23.08	23.22	12	23.44	23.30	10
26				23.00	23.08	10	22.86	22.81	9	12							23.15	23.30	12			
27				22.89	22.97	8	23.08	23.03	9	15							23.00	23.14	12	23.43	23.28	8
June 3				22.75	22.83	7				16							23.10	23.24	11	23.34	23.20	9
4				22.62	22.70	6				19							22.79	22.92	12	23.37	23.22	10
8				23.09	23.17	8				20							23.17	23.31	12			
9				22.84	22.93	9				21							23.13	23.27	12			
10				23.08	23.17	10	23.04	23.01	9	22							23.01	23.15	11			
11							23.06	23.04	1	24										23.22	23.09	7
12				22.96	23.06	3				26							23.18	23.32	12			
14				22.95	23.05	9	22.86	22.84	5	27							22.78	22.91	12	23.52	23.38	3
15				23.02	23.11	10	22.95	22.93	9	28							22.93	23.07	11			
17				22.82	22.91	9	23.07	23.04	7	29							23.20	23.34	12			
18				22.87	22.98	3				Dec. 3							23.17	23.31	10	23.38	23.25	10
20				22.99	23.09	8	22.91	22.89	8	4							22.99	23.12	11	23.40	23.25	10

	IV			I			II			III		
	ϕ_1	ϕ_2	No	ϕ_1	ϕ_2	No	ϕ_1	ϕ_2	No	ϕ_1	ϕ_2	No
1894	//	//		//	//		//	//		//	//	
Dec. 5	23.12	23.26	11	23.21	23.08	10						
6	22.86	22.99	11	23.39	23.24	9						
23				23.25	23.12	10						
27				23.44	23.30	10						
28				23.45	23.33	8						
1895 31				23.46	23.33	10						
Jan 1				23.37	23.25	10						
4				23.10	22.97	10						
11				23.25	23.13	10						
14				23.22	23.10	7						
16				23.19	23.07	10						
19				23.26	23.14	10						
23				23.53	23.41	10						
24				23.40	23.29	10						
27				23.41	23.29	10	23.38	23.37	8			
29				23.40	23.30	2						
31				23.46	23.34	10	23.29	23.28	9			
Feb. 2				23.38	23.27	10	23.15	23.14	8			
Mar. 3				23.47	23.36	10						
5				23.58	23.48	7						
6				23.11	23.00	3						
9				23.46	23.36	10						
10				23.22	23.12	5						
14				23.04	22.95	3						
16							23.24	23.23	10			
17				23.23	23.13	8	23.24	23.23	10			
18				23.47	23.37	7	23.34	23.34	9			
19				23.37	23.27	8						
21				23.22	23.13	6	22.93	22.93	10			
22							23.23	23.23	9			
23				23.41	23.30	5						
25							23.15	23.15	10			
28							22.77	22.78	10			
Apl. 10							23.18	23.19	10			
11							23.12	23.13	10			
14							23.40	23.42	10			
15							23.39	23.42	3			
18							23.23	23.25	10			
19							23.31	23.34	10			
20							23.09	23.12	10			
21							23.17	23.20	10			
23							23.27	23.30	10			
May 1							22.99	23.03	10			
3							23.08	23.13	9			
6							23.13	23.18	10			
9							22.97	23.02	10	22.98	22.91	9
10										22.96	22.89	9
12							22.82	22.89	2			
13							23.01	23.07	9			
16							22.98	23.04	10	23.03	22.97	8

	II			III			IV		
	ϕ_1	ϕ_2	No	ϕ_1	ϕ_2	No	ϕ_1	ϕ_2	No
1895	//	//		//	//		//	//	
May 18	23.07	23.13	10	23.19	23.14	6			
22	22.77	22.83	10	23.16	23.10	9			
23	22.81	22.87	10	23.18	23.13	9			
28	23.20	23.28	10	22.97	22.92	9			
29	22.90	22.98	10	23.17	23.13	9			
30	23.00	23.08	10	23.18	23.14	9			
June 7	22.85	22.94	10	23.05	23.02	9			
8	22.84	22.93	10	23.12	23.09	9			
9	22.97	23.06	10	22.99	22.96	8			
11	23.01	23.10	10	23.08	23.05	9			
14	23.02	23.11	9						
16	23.16	23.27	1						
23	22.89	22.99	10						
25				23.11	23.09	9			
28	22.73	22.84	5						
29	22.80	22.91	3						
July 9				23.01	23.01	9	22.80	22.85	11
10				22.93	22.94	9			
12				23.00	23.01	9	22.94	22.98	7
16				23.08	23.10	7	22.92	22.98	12
18				22.92	22.93	9	22.84	22.88	12
19				22.79	22.80	9	22.91	22.96	12
25				22.99	23.01	9	22.76	22.81	11
26				22.86	22.89	8	22.91	22.96	10
28				22.90	22.93	9	22.92	22.97	12
29				22.67	22.70	7	22.86	22.92	12
30				22.79	22.82	9			
31				22.73	22.76	9	22.82	22.88	11
Aug. 3				22.90	22.94	9			
5				22.69	22.72	7			
7				22.84	22.88	9	23.03	23.11	8
8				22.91	22.95	9			
10				22.89	22.94	9	22.80	22.87	12
12				22.92	22.96	9			
13							22.93	23.01	12
15				22.85	22.90	9	22.75	22.82	11
18				22.83	22.88	9	22.80	22.89	5
19				22.91	22.96	8	22.78	22.87	11

The Constant of Aberration.

In the expression for $\frac{1}{2}(\delta + \delta')$—page 84—the terms $\frac{1}{2}(c' + c_1')C + \frac{1}{2}(d' + d_1')D$ comprise the correction for aberration. Writing for C and D their values as given in the American Ephemeris and calling the expression $\varkappa$, we have

$$\varkappa = 20''.4451[-\tfrac{1}{2}(c' + c_1')\cos\omega\cos\odot - \tfrac{1}{2}(d' + d_1')\sin\odot].$$

Let $20''.4451 + y$ be the true value of the constant of aberration, $\varkappa + \delta\varkappa$ the corresponding correction,

Then $$\kappa + \Delta\kappa = (20''.4451 + y)[-\tfrac{1}{2}(c' + c_1') \cos\omega \cos\odot - \tfrac{1}{2}(d' + d_1') \sin\odot].$$

By division

$$\frac{\kappa}{\kappa + \Delta\kappa} = \frac{20''.4451}{20''.4451 + y}$$

From which $\Delta\varkappa = \varkappa.x$ where x is written for $\frac{y}{20.4451}$

Let ϕ_1, ϕ_2, ϕ_3, ϕ_4 be the values of the latitude given by Groups I, II, III, IV,

Δ_1, Δ_2, Δ_3, Δ_4 the constant part of the correction which these values require,

The true value of the latitude will be

$$\begin{array}{rcl} \varphi & \phi_1 \mid \Delta_1 \mid & \kappa_1 x \\ & \phi_2 \mid \Delta_2 \mid & \kappa_2 x \\ & \varphi_3 \mid \Delta_3 \mid & \kappa_3 x \\ = & \phi_4 \mid \Delta_4 \mid & \kappa_4 x \end{array}$$

Employing the values of ϕ_1, ϕ_2, ϕ_3 and ϕ_4 determined on the same dates and subtracting the consecutive equations we have

$$\begin{aligned} 0 &= \phi_1 - \phi_2 + (\Delta_1 - \Delta_2) + (\kappa_1 - \kappa_2)x \\ &= \phi_2 - \phi_3 + (\Delta_2 - \Delta_3) + (\kappa_2 - \kappa_3)x \\ &\quad \phi_3 - \phi_4 + (\Delta_3 - \Delta_4) + (\kappa_3 - \kappa_4)x \\ &= \phi_4 - \phi_1 + (\Delta_4 - \Delta_1) + (\kappa_4 - \kappa_1)x. \end{aligned}$$

Adding we find $0 = \Sigma\Delta\phi + \Sigma\Delta\varkappa.x$.

For deriving the value of y, those determinations of latitude were employed where both evening and morning observations were obtained on the same or consecutive dates. In three cases two days intervened between the morning and evening observations, and in one case three days.

The details are shown in the table which follows. $\Sigma\phi$ is the sum of the seconds of observed latitude for the date indicated, the foregoing corrections having been applied for reduction to mean declination of group; $\Sigma\varkappa$, is the sum of corrections for aberration.

The process of assembling in groups and formation of equations seems to call for no farther explanation.

Determination of Constant of Aberration.

	No	Σφ	Σκ
I			
1894. Jan. 27	10	32.85	+22.7
31	9	30.40	22.0
Feb. 1			
4			
5	9	29.72	25.8
11	9	28.49	31.8
15	9	28.26	36.5
16	7	22.97	25.2
Feb. 7–5	53	3.258	+ 3.09
I–II		+ .044	+ 19.57
Feb. 23	10	30.51	43.8
24	10	29.46	44.5
26			
27	10	35.69	46.2
Mar. 3	10	34.16	48.6
Feb. 26–26	40	3.245	+ 4.58
		+ .030	+ 20.98
Mar. 8	7	22.37	36.1
12	10	33.60	52.6
13			
14	10	32.51	53.2
16	8	24.78	42.9
17	8	26.48	43.5
Mar. 13–14	43	3.250	5.31
		+ .063	+ 20.22
II			
May 8	10	30.36	— 26.5
9	10	28.21	— 23.7
10	9	26.99	— 18.6
12	10	28.61	— 15.1
May 10–10	39	2.928	— 2.15
II–III		— .188	+ 10.37
May 26	10	30.05	+ 24.5
27	8	23.14	+ 24.5
May 26–26	18	2.955	+ 2.72
		— .017	+ 11.53
June 10	10	30.81	+ 64.6
14	9	26.56	69.1
15	10	30.18	77.6
17	9	25.34	75.9
20	8	23.94	75.2
22	9	25.36	+ 86.5
June 16–16	55	2.949	+ 8.16
II–III		— .018	+ 11.17
June 28	8	23.70	+ 85.7
July 3	7	19.46	80.3
5	7	19.56	+ 83.2
July 2–1	22	2.851	+ 11.33
		— .050	+ 9.82

	No.	Σφ	Σκ
II			
8		24.74	—128.0
9		30.16	—147.2
3		8.42	— 50.8
2		6.14	— 33.6
9		30.17	—151.2
31		3.214	— 16.48
1.96	wt.		
8		23.63	—133.2
9		28.21	—148.8
9		30.17	—147.7
8		27.29	—128.0
34		3.215	— 16.40
1.84	wt.		
3		9.60	— 44.4
5		15.65	— 81.0
10		31.98	—149.5
10		31.41	—147.2
3		10.14	— 40.1
31		3.187	— 14.91
1.80	wt.		
III			
9		28.50	—116.7
8		24.57	—105.5
3		9.82	— 31.3
9		27.47	—109.5
29		3.116	— 12.52
1.66	wt.		
9		25.77	— 80.5
9		27.73	— 78.0
18		2.972	— 8.81
0.90	wt.		
9		27.34	— 44.5
5		14.29	— 11.3
9		26.58	— 32.0
7		21.48	— 21.5
8		23.25	— 17.0
7		20.58	— 9.1
45		2.967	— 3.01
2.47	wt.		
9		26.35	+ 1.6
8		23.42	+ 13.9
4		11.16	+ 16.2
21		2.901	+ 1.51
1.07	wt.		

	No.	Σφ	Σκ
III			
1894. July 9	9	27.95	+ 30.2
12	9	25.33	37.9
13	9	26.67	40.6
17	9	26.68	50.4
24	8	25.31	58.5
25	9	29.09	69.5
July 17–16	53	3.038	+ 5.42
III–IV		+ .071	+ 11.69
Aug. 5	9	26.26	+ 93.9
6	9	24.14	96.2
9	9	26.38	103.2
10	9	27.11	104.1
Aug. 7–7	36	2.886	+ 11.04
		+ .099	+ 12.23
Aug. 20	7	20.64	+ 93.2
22	9	27.37	125.4
23	9	26.63	126.8
24	9	26.70	128.4
31	9	26.31	138.0
Aug. 24–24	43	2.969	+ 14.23
		+ .099	+ 11.30
Sep. 11	9	26.00	+149.6
12	8	23.96	133.9
15	8	22.33	136.0
Sep. 13–13	25	2.892	+ 16.78
		— .045	+ 9.24
IV			
Oct. 6	12	36.89	143.1
11	5	15.78	68.9
15	11	33.44	145.0
16	12	34.77	159.4
17	11	33.24	149.7
18	12	34.86	162.3
19	12	37.45	163.6
Oct. 15–15	75	3.019	+ 13.23
IV–I		— .224	+ 18.87
Oct. 27	11	34.16	156.7
Nov. 1	12	35.55	175.7
2	7	19.23	107.1
3			
4	12	36.88	177.3
6			
10			
11	12	36.97	179.0
12	12	37.84	178.8
Nov. 5–4	66	3.040	+ 14.77
		— .261	+ 19.67

	No.	Σφ	Σκ
IV			
12		34.56	— 96.5
12		35.43	— 88.8
12		35.17	— 86.1
4		11.45	— 19.3
11		34.20	— 51.3
11		33.16	— 46.7
62		2.967	— 6.27
2.86	wt.		
12		36.49	— 21.4
12		33.01	— 18.7
12		31.22	— 9.5
11		30.28	— 6.1
47		2.787	— 1.19
2.04	wt.		
12		33.26	+ 23.3
12		34.81	+ 29.2
11		31.24	+ 32.3
11		32.10	+ 29.5
12		35.03	+ 55.7
58		2.870	+ 2.93
2.47	wt.		
12		35.94	+ 86.1
12		34.17	+ 88.7
12		35.62	+ 96.5
36		2.937	+ 7.54
1.48	wt.		
I			
8		26.61	— 45.6
10		31.57	— 56.7
9		29.03	— 51.8
10		33.25	— 56 0
10		33.06	— 55.9
10		31.34	— 55.6
57		3.243	— 5.64
3 24	wt.		
10		32.46	— 53.5
10		33.77	— 51.6
10		32.95	— 50.6
6		18.88	— 25.1
10		32.35	— 47.2
10		34.42	— 46.5
56		3.301	— 4.90
3.03	wt.		

IV				I			II				III		
	No.	$\Sigma\phi$	$\Sigma\kappa$	*No.*	$\Sigma\phi$	$\Sigma\kappa$		*No.*	$\Sigma\phi$	$\Sigma\kappa$	*No.*	$\Sigma\phi$	$\Sigma\kappa$
1894. Nov. 15	12	35.94	178.6	8	27.45	— 36.5	1895. May 28	10	32.05	+ 29.2	9	26.71	— 76.4
16	11	34.10	164.4	9	30.08	— 37.3	29	10	29.02	32.0	9	28.56	— 74.0
19	12	33.42	177.7	10	33.66	— 41.6	30	10	30.01	34.7	9	28.66	— 71.9
22	11	33.05	161.2										
24				7	22.55	— 22.9	May 29-29	30	3.036	+ 3.20	27	3.109	— 8.23
26	12	38.15	173.6						— .073	+ 11.43	1.42	wt.	
27	12	33.36	172.8	3	10.56	— 4.9							
							June 7	10	28.55	+ 56.1	9	27.47	— 52.6
Nov 21-19	70	2.972	+ 14.69	37	3.359	— 3.87	8	10	28.39	58.7	9	28.12	— 50.0
		— .387	+ 18.56	2.42	wt.		9	10	29.69	61.5	8	23.94	— 45.9
							11	10	30.07	66.7	9	27.75	— 43.6
Dec. 3	10	31.70	142.8	10	33.82	— 30.8							
4	11	32.84	154.3	10	33.96	— 30.1	June 9-9	40	2.918	+ 6.08	35	3.065	— 5.49
5	11	34.32	153.1	10	32.09	— 29.1			— .147	+ 11.57	1.87	wt.	
6	11	31.43	152.0	4	30.47	— 28.2							
							June 23	10	28.86	+ 93.7			
Dec. 5-4	43	3.030	+ 14.00	39	3.342	— 3.02	25				9	27.96	— 7.5
		— .312	+ 17.03	2.05	wt.		28	5	13.64	57.0			
I				II									
1895. Jan. 27	10	34.08	+ 22.2	8	27.04	—127.8	June 25-25	15	2.833	+ 10.05	9	3.107	— 0.84
31	10	34.60	25.9	9	29.62	—146.3			— .274	+ 10.89	0.56	wt.	
Feb. 2	10	33.80	27.6	8	25.19	—132.1							
							III				IV		
Jan. 30 30	30	3.416	+ 2.52	25	3.274	— 16.25	July 9	9	27.08	+ 29.5	11	30.82	— 85.8
I-II		+ .142	+ 18.77	1.36	wt.		12	9	26.98	37.0	7	20.56	— 44.6
							16	7	21.58	37.6	12	35.09	— 78.9
Mar. 14	3	9.12	17.0				18	9	26.24	52.1	12	34.10	— 74.0
16				10	32.40	—147.5	19	9	25.09	54.6	12	34.88	— 70.8
17	8	25.88	43.4	10	32.38	—146.0							
18	7	24.28	38.1	9	30.10	—129.6	July 15-15	43	2.953	+ 4.90	54	2.879	— 6.56
21	6	19.32	32.7	10	29.32	—140.0	III-IV		+ .074	+ 11.46	2.39	wt.	
22				9	29.09	—125.5							
23	5	17.04	27.5				July 25	9	26.90	+ 68.8	11	30.31	— 50.0
25				10	31.53	—133.1	26	8	22.91	62.4	10	29.07	— 48.0
							28	9	26.09	75.9	12	35.04	— 45.7
Mar. 19-20	29	3.298	+ 5.47	58	3.187	— 14.17	29	7	18.71	58.1	12	34.34	— 44.0
		+ .111	+ 19.64	1.93	wt.		31	9	24.58	82.5	11	31.02	— 33.3
II				III									
							July 28-28	42	2.838	+ 8.28	56	2.853	— 3.95
May 9	10	29.72	— 24.4	9	26.79	—115.4			— .015	+ 12.23	2.40	wt.	
10				9	26.60	—113.7							
12	2	5.64	+ 2.3				Aug. 7	9	25.57	+ 97.7	8	24.26	— 1.9
16	10	29.84	— 4.5	8	24.22	— 91.2	10	9	26.05	103.4	12	33.62	— 7.5
18	10	30.72	+ 1.3	6	19.16	— 59.1	12	9	26.26	107.4			
22	10	27.67	+ 12.3	9	28.39	— 89.8	13				12	35.16	+ 1.8
23	10	28.08	+ 15.3	9	28.63	— 87.5	15	9	25.65	112.9	11	30.20	+ 7.8
							18	9	25.50	118.5	5	13.99	+ 17.5
							19	8	23.30	105.9	11	30.58	+ 21.2
May 17-16	52	2.917	+ 0.04	50	3.076	— 11.13	Aug. 13-13	53	2.874	+ 12.18	59	2.844	+ 0.66
II-III		— .159	+ 11.17	2.55	wt.				+ .030	+ 11.52	2.79	wt.	

In combining the foregoing expressions to form the final equation the weights are given by the formula

$$p = \frac{nn'}{10\,(n + n')}.$$

The two series of values for I–II, II–III, and III–IV have been combined by weights in the final expressions given below.*

		$\Delta\phi$	κ	$Wt.$			$\Delta\phi$	κ	$Wt.$
1894. Feb. 6	I—II	+.044	+19.57	1 96					
26		+.030	20.98	1.84	1895. Jan. 30	I—II	+.142	+18.77	1.36
Mar. 14		+.063	20.22	1.80	Mar. 20		+.111	19.64	1.93
Mean		+.0455	+20.24	5.60	Mean		+.1238	+19 28	3.29
May 10	II—III	—.188	+10.37	1.66	May 17	II—III	—.159	+11.17	2.55
26		—.017	11.53	0.90	29		—.073	11.43	1.42
June 16		—.018	11.17	2.47	June 9		—.147	11.57	1 87
July 2		—.050	9.82	1.07	25		—.274	10.89	0.56
Mean		—.0697	+10.77	6.10	Mean		—.1465	+11.32	6.40
July 17	III—IV	+.071	+11.69	2.86					
Aug. 7		+.099	12.23	2.04	July 15	III—IV	+.074	+11.46	2.39
24		+.099	11.30	2.47	28		—.015	12 23	2.40
Sep. 13		—.045	9.24	1.48	Aug. 13		+.030	11.52	2.79
Mean		+.0659	+11.30	8.85	Mean		+.0296	+11.73	7.58
Oct. 15	IV—I	—.224	+18.87	3.24					
Nov. 5		—.261	19.67	3.03					
20		—.387	18.56	2.42					
Dec. 4		—.312	17.03	2.05					
Mean		—.2880	+18.67	10.74					

$$
\begin{aligned}
19.88\,x + \quad .0745 &= 0\\
11.05\,x - \quad .1090 &= 0\\
11.50\,x + \quad .0492 &= 0\\
18.67\,x - \quad .2880 &= 0\\
61.10\,x - \quad .2733 &= 0
\end{aligned}
$$

$$
\begin{aligned}
x &= +\,0.004473\\
y &= \quad .0915\\
&\quad\; 20.4451
\end{aligned}
$$

Aberration $20''.5366$

Adopting this value of the constant of aberration as that best suited to present purposes, the necessary correction to the latitude is found by multiplying the computed reduction for aberration by the factor .004473.

After applying these corrections to the latitudes we are prepared to form the condition equations for adjusting the declination systems of the different groups in order to free the results from systematic differences.

*If we reduce these as two separate series, the term IV–I appearing in both, we find for the constant of aberration—

First series, $20''.5277$
Second " 20 .5393.

The Latitude.

Assembling the corrected latitudes in groups covering convenient periods, which in the present case have an average duration of about sixteen days, we have the results given below. As before $p = \frac{nn'}{10(n+n')}$.

		I	No.	II	No.	III	No.	IV	No.		$\Delta\phi$	p	$\frac{I}{p}$
		"		"		"		"					
1894.	Jan. 19–Feb. 16	3.201	100	3.140	31					II—I	—.061	2.37	
	Feb. 19–Mar. 3	3.235	46	3.141	34					$_2v_1$	—.094	1.95	
	Mar. 4–Mar. 18	3.322	71	3.137	40						—.185	2.56	
											—.1165	6.88	.1453
	Mar. 19–Apl. 15			3.117	49								
	Apl. 16–Apl. 30			3.104	51								
	May 8–May 13			2.930	43	3.060	29			III II	+.130	1.73	
	May 26–June 15			2.961	80	2.944	42			$_3v_2$	—.017	2.75	
	June 17–July 5			2.908	59	2.934	43				+.026	2.49	
											| .0348	6.97	.1435
	July 9–July 25					3.037	59	2.939	62	IV—III	—.098	3.02	
	Aug. 5–Aug. 22					2.968	61	2.803	71	$_4v_3$	—.165	3.28	
	Aug. 23–Sep. 15					2.991	60	2.941	70		—.050	3.23	
											—.1048	9.53	.1049
	Oct. 2–Oct. 20	3.218	57					3.067	110	I—IV	+.151	3.75	
	Oct. 27–Nov. 12	3.269	66					3.106	66	$_1v_4$	+.163	3.30	
	Nov. 15–Nov. 27	3.342	37					3.082	94		+.260	2.65	
	Nov. 28–Dec. 6	3.328	39					3.107	66		+.221	2.45	
											+.1921	12.15	.0823
1894–1895.													
	Dec. 23–Jan. 4	3.339	58										
	Jan. 11–Jan. 24	3.319	57										
	Jan. 27–Feb. 2	3.427	32	3.201	25					II- I	—.226	1.40	
	Mar. 3–Mar. 28	3.391	72	3.063	68					$_2v'_1$	—.328	3.50	
											—.2989	4.90	.2041
	Apl. 10–Apl. 19			3.217	53								
	Apl. 20–May 6			3.099	59					III—II	+.072	4.17	
	May 9–May 30			2.970	91	3.042	77			$_3v'_2$	+.109	2.67	
											+.0864	6.84	.1462
	June 7–June 29			2.944	68	3.053	44						
	July 9–July 31					2.919	103	2.842	110	IV—III	—.077	5.08	
	Aug. 3–Aug. 19					2.917	78	2.847	59	$_4v'_3$	—.079	3.36	
											—.0742	8.44	.1185

If we represent by $_2v_1, _3v_2$ . . . . the required corrections to the observed differences (II-I), (III–II) . . . . the following conditions must be satisfied:

$$
\begin{array}{lllll}
{}_2v_1 + {}_3v_2 + {}_4v_3 + {}_1v_4 & & & & = +0056 \\
{}_2v_1 & - {}_2v'_1 & & & = +1824 \\
{}_3v_2 & & - {}_3v'_2 & & = -0516 \\
{}_4v_3 & & & - {}_4v'_3 & = -0306
\end{array}
$$

Employing the weights given in the table preceding and solving our equations by the method of correlates, we find the following normal equations:

$$\begin{array}{l} .4760\,k + .1453\,k' + .1435\,k'' + .1049\,k''' = +.0056 \\ .1453\,k \mid .3494\,k' \qquad\qquad\qquad\qquad \mid .1821 \\ .1435\,k \qquad + .2897\,k'' \qquad\qquad = -.0516 \\ .1049\,k \qquad\qquad + .2234\,k''' = -.0306 \end{array}$$

From which

$$\begin{array}{l} k = -.1026 \\ k' = +.5647 \\ k'' = -.1272 \\ k''' = -.0888 \end{array}$$

Also

$$\begin{array}{lll} {}_2v_1 = & .1453(k + k') & = +.0671 \\ {}_3v_2 = & .1435(k + k'') & = -.0330 \\ {}_4v_3 = & .1049(k + k''') & = -.0201 \\ {}_1v_4 = & .0823\ k & = -.0084 \\ {}_2v'_1 = & -.2041\ k' & = -.1153 \\ {}_3v'_2 = & -.1462\ k'' & = +.0186 \\ {}_4v'_3 = & -.1185\ k''' & = +.0105 \end{array}$$

Therefore for the corrected differences

$$\begin{array}{l} \text{II} - \text{I} = -.1836 \\ \text{III} - \text{II} = +.0678 \\ \text{IV} - \text{III} = -.0847 \\ \text{I} - \text{IV} = +.2005 \end{array}$$

The algebraic sum should, of course, be zero.

From these relations

$$\begin{array}{l} \text{I} = \text{II} + .1836 \\ \text{III} + .1158 \\ \text{IV} + .2005 \end{array}$$

Subtracting 0.1250 from each side of our equations in order to make the sum of the corrections zero, we obtain the following values, which must be applied to the latitudes derived from the respective groups in order to reduce all to a homogeneous system:

$$\begin{array}{l} \text{I} - 0.''125 \\ \text{II} + 0.059 \\ \text{III} - 0.009 \\ \text{IV} + 0.075 \end{array}$$

Applying these corrections to the values of the latitudes given on page 150, we obtain the final results, as follows:

Final Values of Latitude—All Corrections Applied.

Weighted Mean Date.			*I*	*No.*	*II*	*No.*	*III*	*No.*	*IV*	*No.*	*Mean* ϕ
1	1894	Feb. 4	3.076	100	3.199	31					3.137
2		Feb. 25	3.110	46	3.200	34					3.155
3		Mar. 13	3.197	71	3.196	40					3.196
4		Apl. 9			3.176	49					3.176
5		Apl. 25			3.163	51					3.163
6		May 10			2.989	43	3.051	29			3.020
7		June 6			3.020	80	2.935	42			2.977
8		June 25			2.967	59	2.925	43			2.946
9		July 16					3.028	59	3.014	62	3.021
10		Aug. 13					2.959	61	2.878	71	2.918
11		Sep. 5					2.982	60	3.016	70	2.999
12		Oct. 14	3.093	57					3.142	110	3.117
13		Nov. 4	3.144	66					3.181	66	3.162
14		Nov. 21	3.217	37					3.157	94	3.187
15		Dec. 4	3.203	39					3.182	66	3.192
16		Dec. 29	3.214	58							3.214
17	1895	Jan. 18	3.194	57							3.194
18		Jan. 31	3.302	32	3.260	25					3.281
19		Mar. 17	3.266	72	3.122	68					3.194
20		Apl. 15			3.276	53					3.276
21		Apl. 27			3.158	59					3.159
22		May 20			3.029	91	3.033	77			3.031
23		June 13			3.003	68	3.044	44			3.024
24		July 21					2.910	103	2.917	110	2.914
25		Aug. 12					2.908	78	2.922	59	2.915
				635		751		596		708	

The folded sheet which follows gives the individual values of the seconds of latitude, all corrections and reductions having been applied.

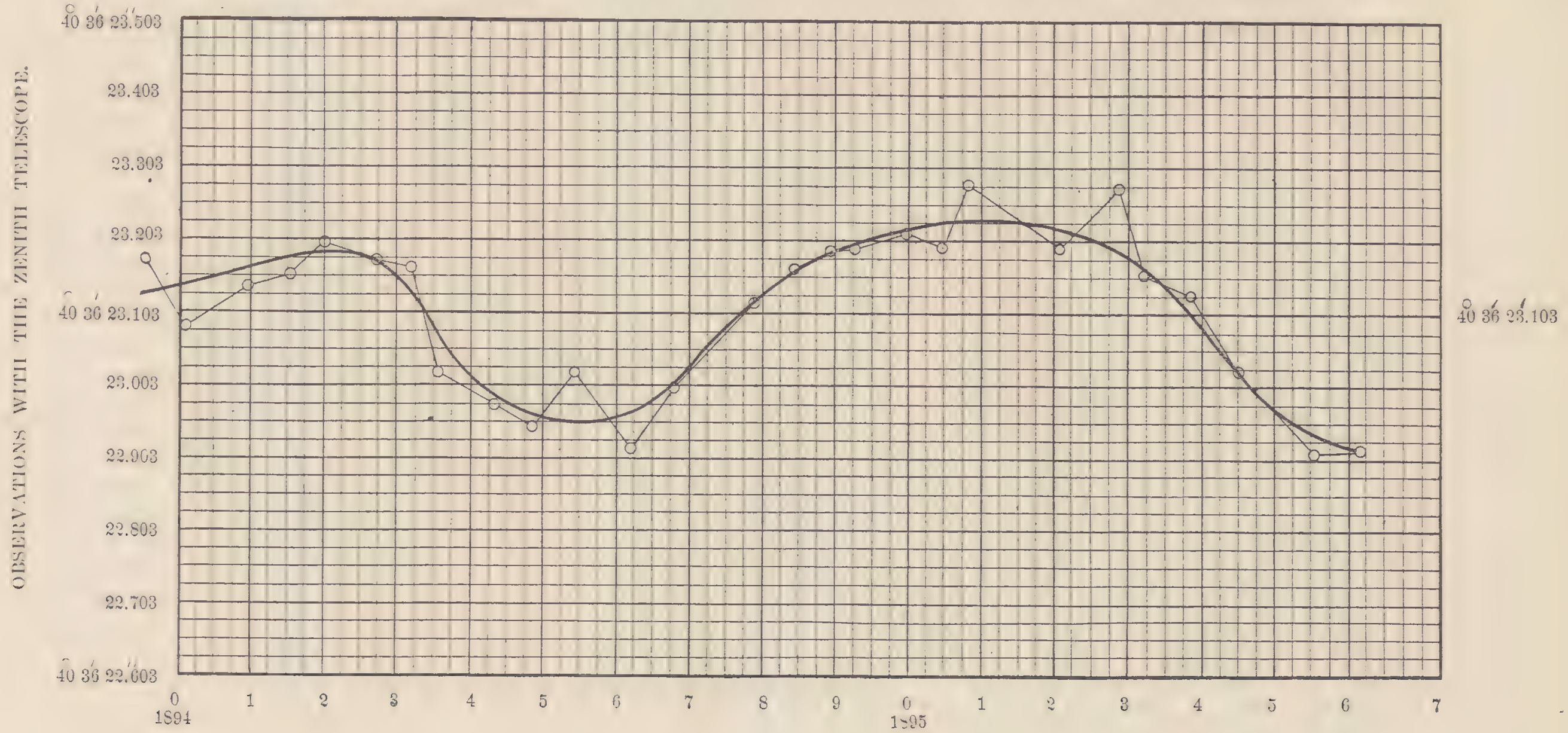
The probable error of a single determination has been derived from these final values, and therefore includes that part due to the adjusted declinations as well as that of observation.

The results are as follows:

For Group	I	$r = 0''.218$	from 635 residuals
	II	.212	751
	III	.189	596
	IV	.193	708
Mean		$r = 0''.208$	2690 = whole number of latitude determinations.

Date	I										II										III									IV											
	1751	1862	1923	1970	2045	2139	2187	2301	2365	2439	4694	4728	4825	4874	4926	4974	5072	5147	5210	5271	5941	6122	6193	6232	6473	6476	6584	6599	6697	7509	7561	59.2444	7760	7820	7915	7962	8024	8078	8195	8252	8317
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	10	11	12
1894 Jan. 19.	3.23	2.94	3.81	3.12	3.67	2.79	3.50	2.87	3.01	3.28																															
25.	2.74	2.79	2.67	3.23	2.52	2.21	2.56	2.83	2.64	2.51																															
27.	3.11	3.34	3.40	2.86	3.32	2.98	3.33	2.94	3.54	2.89	2.97	3.62	2.40	3.03	3.12	2.38	2.99	4.17																							
28.	3.64	3.45	3.31	3.64	3.08	2.63	2.83																																		
30.	2.87	2.69	2.90	2.63	2.21	2.47	2.65	3.01	3.20	3.40																															
31.	3.25	3.41		3.72	2.90	3.27	3.14	3.54	3.24	2.91																															
Feb. 1.											3.05	3.42	3.27	3.53	3.67	2.70	3.71	3.48		3.20																					
4.											2.76	3.28	2.32																												
5.	2.48	3.70		2.92	3.35	3.40	3.33	2.19	3.84	3.50																															
6.	2.93	2.29	3.11	3.60	2.96	3.85	3.15	3.17	3.01	3.18																															
11.	2.93	3.76	2.60	2.63	3.03		3.25	2.49	3.58	3.22	2.99	3.11																													
15.	3.16	3.43	3.24	2.97	2.99	2.66	3.01	2.68	3.17																																
16.	[4.42]	[3.87]	3.22	3.69	2.87	2.68	[3.96]	3.28	2.98	3.49	3.64	2.61	3.22	4.30	3.62	2.89	3.22	3.11		3.41																					
19.	2.89	3.29	2.82																																						
20.		2.52	2.72	3.19																																					
23.	2.79	2.87	3.08	2.73	2.19	3.27	2.98	2.82	3.52	3.22	3.77	2.93	2.30	3.32	3.06	2.68	2.71			2.74																					
24.	2.92	3.07	2.64	2.93	3.42	2.86	2.65	2.43	2.93	2.57	2.93	2.25	3.02	3.52	2.83	3.21	3.45	3.50		3.37																					
26.											3.34	3.48	3.26	2.69	3.87	3.33	3.69	2.66		3.73																					
27.	3.97	3.18	3.31	3.63	3.47	3.21	3.45	3.29	3.60	3.55																															
Mar. 3.	3.51	3.21	3.99	3.41	3.07	3.22	3.22	3.19	3.38	2.94	3.93	3.87	3.12	2.76	3.14		4.11	3.20		3.06																					
4.	3.09	2.82	3.36	3.20	2.80	3.57	2.80	3.46	3.64	3.44	3.43	2.90	3.29	3.19	3.39	3.21	2.88	3.50		3.51																					
7.	3.08	3.42	3.56	3.69	3.79	3.34	3.41	3.66	3.43	3.12																															
8.	3.06	3.32	3.61		3.06	2.62		2.91		3.08	3.08	2.91	3.59																												
12.	3.09	3.39	3.49	3.28	2.99	3.39	3.19	3.04	3.29	3.44																															
13.																3.10	3.14	3.14	2.93	3.28																					
14.	3.05	3.24	3.24	3.38	2.64	2.89	3.21	3.25	3.26	3.31	3.55	2.89	3.34	3.16	3.34	3.09	2.71	3.29	3.05	3.50																					
16.			2.94	2.62	3.87	2.74	3.38	2.51	3.23	2.73	3.27	3.65	2.84	3.28	3.20	2.55	3.25	3.09	3.17	3.05																					
17.			3.37	3.04	3.22	3.08	3.17	3.25	3.15	3.45	3.15	3.28	3.71																												
18.			3.11	2.65	3.25	2.89	3.26	3.24	3.47	3.07																															
19.											3.19	3.15	4.06	2.67	3.25	2.15	3.66	3.34		2.45																					
April 6.											3.58	[4.04]																													
7.											3.31	3.87	[1.72]	2.65	3.24	3.00	2.21	2.91	2.40	3.41																					
13.											3.58	3.71	3.36	3.48	3.89	3.12	3.76	3.12	3.10	3.24																					
14.											3.39	3.26	3.02	3.23	3.31	4.01	2.76	2.75	3.40	3.24																					
15.											2.85	3.38	3.22	2.83	3.35	3.29	3.38	2.54	2.82	3.20																					
16.											3.26		3.15																												
22.											3.22	3.47	2.94	3.10	3.23	3.77	3.18	3.57	2.83	3.29																					
24.											2.81	3.12	3.14	3.09	3.20	2.79	3.55	2.56	2.60	3.10																					
25.											3.39	3.49	2.69	2.95	2.62	3.46	2.60	3.47	3.05	3.37																					
26.											3.49	2.93	3.51	3.20	3.32	2.91	3.38	3.41	2.85	3.20																					
30.											3.45	3.64	2.82	2.87	3.19	3.61	3.04	3.18	3.31	[4.32]																					
May 8.											3.43	2.80	3.13	3.05	3.11	3.39	2.84	3.04	3.09	2.95	3.25	3.24	3.36	2.88	2.89	2.86	2.98	3.48	2.94												
9.											2.78	3.49	2.60	2.64	2.77	2.21	2.89	3.17	3.05	3.10		3.03	2.68	2.90	2.96	3.00	3.05	3.01	3.43												
10.											2.87	2.96	3.10	3.21	2.70		3.60	3.73	2.69	2.57	3.13	3.29	3.24																		
12.											2.77	3.03	2.81	2.66	2.87	3.37	3.23	2.90	2.72	2.77	3.09	3.26	2.60	2.56	3.02	3.28	2.61	2.84	3.65												
13.											2.81	3.40	3.20	[1.88]	3.02																										
26.											3.17	3.16	2.89	3.08	3.37	3.08	3.04	3.06	3.01	2.89	3.02	3.26	2.79	2.67	2.71	2.72	2.78	2.21	3.16												
27.											3.09	2.99	2.92	2.74	2.81	3.10			3.06	3.01	3.25	3.28	2.28	3.35	3.12	3.26	2.57	2.66	3.53												
June 3.											2.90	2.91	2.89	2.74	2.71	2.80	2.89																								
4.											2.78	2.71	2.45	3.04	2.85	2.37																									
8.											3.05		2.91	3.06	3.40	2.73	3.15	3.40	3.69																						
9.											3.18	3.34	2.88	2.32	2.82	3.00	3.44	2.66		2.72																					
10.											3.33	3.12	3.08	3.04	2.83	2.90	3.34	3.39	3.64	3.02	2.99	3.41	2.94	2.97	3.15	3.01	2.99	2.73	2.86												
11.																					3.05																				
12.											3.25	3.12	2.81																												
14.											3.10	2.89	2.98	3.09	2.73	3.47	2.79	2.96	[1.66]	3.39	2.87	2.96	2.53	2.60	3.23																
15.											3.26	2.89	2.98	2.51	3.14	3.01	3.31	3.68	3.00	3.33	3.18	3.20	2.83	3.26	2.46	3.14	3.14	2.69	2.46												
17.											2.76	2.84	2.99	2.88	2.80	2.94	2.73	2.67		3.51	3.25		2.39	3.42	2.91	3.15	[3.72]	2.92	3.28												
18.											3.06	2.64	3.24																												
20.											3.14	3.60	3.08	2.75	3.05	2.67	3.26			3.21	3.19	3.44	2.76	2.54		2.71	2.97	2.73	2.77												
22.											2.53	3.21	3.11	3.07	2.43	2.94	2.96	3.22		2.80	2.93	2.75	2.55	2.89		3.30		2.99	3.06												
27.												2.77	2.94	3.12	2.71	3.03	3.19	3.08		2.91																					
28.												3.13	3.21	3.12	3.16	2.96	2.94	3.30		2.75	3.06	2.95	2.94	2.61	2.83	3.05	3.02	2.85	2.98												
July 3.													2.49	2.76	2.95	2.82	3.24	2.81		3.17	2.96	2.85	2.33	3.46	2.94		2.47	3.12	3.29												
5.													2.97	2.87	2.94	2.70	2.75	3.19		2.92	2.87	3.09	3.08	2.16																	
9.																					2.96	2.84	2.94	3.11	3.32	3.24	3.10	3.08	3.41	2.92	3.12	2.70	3.05	3.35	3.07	2.78	2.94	2.29	3.14	3.05	2.62
10.																					2.73	3.16	2.57	2.71	2.31																
11.																					3.34																				
12.																					2.94	2.98	3.10	2.60	2.59	2.69	2.72	3.10	2.71	2.68	3.25	2.41	2.82	3.14	3.62	2.63	3.08	3.18	3.29	2.30	3.53
13.																					3.44	2.86	2.77	3.37	2.87	3.01	2.98	2.24	3.24	3.03	2.54	2.98	3.19	2.92	2.95	2.99	2.91	2.95	3.07	3.07	3.07
17.																					3.30	3.21	2.83	2.77	2.66	2.88	3.06	3.28	2.83	2.83	2.97		3.11	2.76							
24.																					3.56	[5.04]	2.77	3.04	3.40	3.28	2.99	3.07	3.38	3.25	3.07	2.62	3.16	3.26		2.94	3.35	3.30	3.70	2.31	3.83
25.																					3.43	3.79	2.64	2.84	3.29	3.33	3.68	2.79	3.52	3.06	3.08	2.20	3.34	2.92	2.87	2.94	2.55	3.73	3.58	[1.87]	3.49
Aug. 5.																					2.40	3.38	3.07	2.73	3.21	2.89	3.06	3.13	2.73	3.31	3.00	3.21	3.04	3.33	2.88	3.12	3.02	3.18	3.02	3.42	2.75
6.																					2.58	2.59	3.22	2.67	2.86	2.67	2.49	2.98	2.43	2.80	2.95	2.83	2.95	2.63	3.12	2.97	2.92	2.73	2.64	3.00	2.39
9.																					2.56	2.81	3.07	3.41	2.83	2.75	2.93	3.31	3.09	3.33	2.32	2.88	2.71	2.70	2.59	2.62	2.59	2.45	2.56	2.70	2.63
10.																					3.01	2.51	3.64	3.37	3.00	2.91	2.99	3.14	2.92	3.11	2.76	3.01	2.69	2.65		2.72	2.29	3.02	3.15	2.98	2.70
20.																						2.65	2.95		2.79	2.67	3.24	3.35	3.34	2.78	2.59	3.12	2.97	3.18	2.93	2.99	2.89	2.96	2.05	3.48	2.32
21.																					2.71	2.42	3.58	2.51	3.07	2.98	3.46	2.94	2.66												
22.																					3.21	2.41	2.70	3.60	3.30	3.07	2.98	3.29	3.29	2.89	3.20	2.89	2.89	3.04	3.16	2.97	2.94	2.75	2.78	2.97	3.37
23.																					2.83	3.12	3.35	3.30	2.82	2.60	2.97	3.47	2.65	2.42	2.99	3.17	3.26	2.90	2.98	2.90	3.01	2.62	3.18		2.78
24.																					2.68	2.75	2.67	3.28	3.57	3.09	2.78	3.37	2.99		2.93	2.84	3.45	2.70	3.05	3.14	3.18	3.07	3.01	2.91	2.77
31.																					2.81	2.90	3.13	2.79	2.97	3.08	3.23	3.17	2.77	3.32	3.11	3.10	3.39	2.53	2.57	3.31	3.09	2.93	2.96	3.27	2.60
Sept. 7.																					3.08	2.82	2.76		2.97	2.99	2.89	3.30	2.97												
11.																					3.05	2.52	3.30	3.12	3.09	3.09	2.89	2.84	2.69	3.25	3.07	3.19	3.01	3.06	2.76	2.97	3.74	2.98	3.22	2.93	3.06
12.																					3.04	3.27	2.91	2.57		3.14	2.90	3.34	3.32	2.81	2.64	2.86	3.14	2.92	2.98	2.94	3.36	2.76	2.86	2.96	3.23
15.																						2.92	2.86	2.84	3.17	2.69	2.74	3.10	2.55	3.06	3.14	3.02	3.35	2.88	3.18	2.71	3.31	3.28	2.97	2.87	3.19
Oct. 2.																														3.26	2.74	3.10	2.59	3.16	2.85		3.16	3.57	3.20	3.25	3.54
5.																														2.89	3.21	2.97	2.94	2.94	3.17	3.03	2.91	3.15	3.60	2.98	3.60
6.	2.98	3.58	3.10	2.85	3.43	2.90	3.41	3.16																						2.89	3.01	3.72	3.49	3.62	3.12	3.38	3.15	2.71	2.81	3.50	3.03
11.	3.48	3.20	2.25	1.91	3.04	3.45	2.87	3.37	3.27	3.20																				3.54	3.26	3.11	3.39	3.16							
15.																														3.23	3.01	3.71	2.83	3.45	3.19	3.38		2.87	3.09	3.27	2.89
16.		2.65	3.44	2.81	3.26	3.06	3.34	2.56	3.38	3.18																				3.25	3.12	2.63	2.56	2.69	3.34	3.02	2.88	3.60	2.82	2.98	3.52
17.	3.49	3.17	3.11	3.23	3.18	3.13	2.81	3.52	3.34	2.78																				2.90	3.18	2.85	2.97	3.91	2.88	2.97	3.44	3.42	2.77	3.46	
18.	3.08	3.16	3.05	2.58	3.61	3.26	2.96	3.01	3.09	3.77																				3.13	3.41	2.95	2.83	2.93	3.49	2.95	3.02	2.73	2.88	3.40	2.78
19.	2.91	2.76	2.71	3.29	2.63	3.33	2.38	3.81	2.72	3.31																				3.19	3.00	3.36	3.17	3.46	2.72	3.57	3.67	2.98	3.42	3.39	3.18
20.																														3.54	3.18	2.96	3.08	3.15	3.31	3.23	2.48	3.21	3.15	2.98	3.09
27.	2.84	2.76	3.52	2.75	3.23	3.20	3.01	3.18	3.02	3.47																				3.21	3.01	3.51	3.08	3.37	2.90		3.58	3.03	2.96	3.65	3.38
31.	3.32	3.26	2.88	3.26	3.26	2.76	3.14	3.50	2.62	2.92																															
Nov. 1.	3.57	3.04	3.50	3.08	3.52	2.95	3.21	3.23	2.90	3.29																				2.91	2.73	3.08	3.20	3.08	3.20	3.25	3.17	3.09	3.37	2.90	3.24
2.																														2.70	2.69	2.95	3.00	3.05	2.79	3.05					
3.	3.32	3.34	2.89	3.12	3.07	2.98	3.34	3.24	3.12	3.06																															
4.																														3.44	3.38	2.82	2.70	3.29	3.27	3.32	3.16	3.61	3.50	3.19	2.90
6.	2.83	3.29	3.01	2.45	3.31	3.12																																			
10.	3.12	3.51	2.84	3.27	2.66	3.15	3.27	2.69	3.23	3.15																															
11.	3.47	3.28	3.40	3.25	3.68	3.08	3.07	3.48	3.27	2.98																				3.19	3.13	3.28	3.49	3.30	3.00	3.24	3.34	3.03	3.36	3.20	3.12
12.																														3.16	3.20	2.88	3.13	3.43	3.93	3.04	3.27	3.72	3.83	2.55	3.40
15.	3.28	[4.30]	3.07	3.35	3.04	3.20		3.45	3.33	3.59																				3.12	3.41	3.42	3.13	3.14	2.78	3.24	3.08	2.96	2.96	3.35	3.05
16.	2.39	3.42	3.69	2.69	3.33	2.75	3.41	3.64		3.47																				2.93		3.15	3.28	2.80	4.06	2.92	2.74	3.36	3.53	3.01	3.88
19.	3.29	3.22	3.20	3.23	3.05	3.40	3.05	3.73	3.14	2.91																				2.87	2.87	3.47	3.33	2.82	2.83	3.31	2.59	3.03	2.18	2.68	3.13
20.																														3.45	3.39	2.89	2.78	3.53	3.43	3.13	3.30	3.19	3.83	3.09	3.67
21.																														3.78	2.90	3.47	3.06	3.43	3.01	3.29	3.56	3.38	3.05	3.04	3.25
22.																														3.47	3.22		3.30	3.03	2.23	3.02	2.82	2.92	3.29	3.35	2.95
24.	2.73	3.77	3.45	2.45		2.97	2.60	3.61																																	
26.																														3.43	3.40	3.66	3.28	3.21	3.07	3.36	3.20	3.10	3.19	3.47	3.44
27.	3.38	3.42	3.37																											2.61	3.11	2.94	2.61	2.63	2.70	2.56	2.56	3.88	2.75	3.16	3.42
28.																														2.70	2.69	3.07	3.00	[5.38]	3.13	3.51	2.96	2.62	2.68	3.50	3.86
29.																														2.71	3.68	3.37	3.37	3.27	3.17	3.55	3.34	3.55	3.68	3.11	3.27
Dec. 3.	3.41	3.01	3.49	2.97	3.65	2.84	3.53	3.14	3.07	3.29																						3.55	3.26	3.19	3.28	3.30	3.36	3.34	3.25	3.44	3.11
4.	3.46	3.40	2.73	3.53	3.10	3.22	3.23	3.66	2.81	3.51																					2.89	3.22	2.73	2.88	3.04	3.35	3.11	3.41	3.69	2.93	3.10
5.	2.92	3.03	3.18	2.58	3.26	3.06	3.83	2.83	3.17	3.34																					3.63	3.52	3.29	3.27	3.23	3.56	3.33	2.43	2.94	3.55	3.08
6.		3.48	2.96	3.75	3.22	3.17	2.87	3.40	3.07	3.34																					2.95	2.69	2.85	2.91	3.31	2.74	2.76	2.95	3.34	3.34	3.10
23.	3.18	3.05	3.28	2.90	2.93	2.88	3.72	2.96	2.57	3.72																															
27.	2.94	3.79	3.47	3.72	2.75	2.98	2.90	3.97	3.83	2.77																															
28.	2.80	3.18	[4.78]	3.65	3.65	2.83	4.21	2.71		3.53																															
31.	3.33	2.96	2.85	3.72	3.19	3.42	3.40	3.13	3.04	3.29																															
1895 Jan. 1.	3.00	2.49	3.28	3.57	4.01	3.41	3.89	2.88	2.66	3.24																															
4.	2.91	2.85	2.96	3.14	3.64	3.73	3.08	2.47	2.24	2.73																															
11.	3.04	3.88	3.32	2.82	3.23	3.05	2.78	3.18	3.26	3.22																															
14.		3.21		3.42	2.71		2.79	3.60	2.92	3.02																															
16.	3.18	3.17	2.87	2.55	3.44	3.21	3.40	2.65	3.34	2.94																															
19.	3.00	3.03	2.72	3.05	2.90	3.55	2.71	3.81	3.92	3.18																															
23.	3.23	3.88	3.95	2.94	3.56	3.37	3.66	2.85	3.42	3.31																															
24.	3.71	3.45	3.14	3.45	2.98	3.38	3.33	3.38	3.00	2.99																															
27.	2.78	3.56	3.35	3.70	3.22	3.38	3.43	2.64	3.53	3.34	3.19	3.57	3.70	3.39	3.80	3.03	2.76	3.49																							
29.	3.00	3.58																																							
31.	3.34	3.37	3.80	3.79	3.33	3.36	3.35	3.15	3.12	3.36	2.29	3.40	3.65	3.62	3.27	3.93	2.93	2.72	3.68																						
Feb. 2.	3.24	3.69	3.37	3.21	3.40	3.11	3.27	3.46	2.66	3.26	2.92	3.45	3.03	4.14		3.77	2.39	2.86	2.50	[4.58]																					
Mar. 3.	3.30	3.54	2.58	3.96	3.20	3.65	3.83	3.51	3.63	3.00																															
5.	3.54	3.44	3.44	[1.16]	3.62	2.94	4.09			3.29																															
6.	2.71		3.05	3.26																																					
9.	3.23	3.08	3.79	3.09	3.46	3.20	3.73	3.15	3.98	2.87																															
10.	2.98	3.09	3.33	2.88		3.31																																			
14.		3.93	2.71	2.18																																					
16.											2.60	3.39	3.51	3.51	3.58	3.48	3.12	3.03	2.99	3.13																					
17.			3.23	3.17	2.78	3.31	3.17	3.41	2.98	3.03	3.38	3.60	2.95	3.44	2.79	3.09	2.84	3.56	3.37	3.30																					
18.			3.54	3.23	[2.28]	3.26	3.62	3.16	3.66	3.11	3.33	3.42	3.65	3.35	3.58		3.40	3.24	3.17	2.91																					
19.			3.21	3.15	3.00	3.30	3.50	3.47	3.51	3.05																															
21.					3.25	2.85	3.14	3.03	3.13	3.32	2.60	3.19	3.04	2.91	2.96	2.66	3.04	2.87	2.82	3.18																					
22.											3.66	3.91	2.58		3.16	2.72	3.40	3.00	3.21	3.41																					
23.						2.92	3.31	3.73	3.45	3.13																															
25.											3.17	2.91	2.85	3.73	3.41	3.11	3.03	3.26	3.26	2.79																					
28.											2.63	2.68	2.82	2.43	2.58	2.68	3.17	2.75	3.05	2.97																					
Apl. 10.											2.88	3.45	3.07	3.23	3.36	3.46	3.23	3.06	2.90	3.30																					
11.											3.03	3.62	3.28	3.03	2.99	2.99	3.60	2.66	2.96	3.18																					
14.											3.53	3.84	3.25	3.68	3.13	3.43	3.64	3.43	3.69	3.07																					
15.											3.41	3.13	3.67																												
18.											3.19	3.82	3.56	2.80	3.78	3.53	3.86	3.22	2.93	2.64																					
19.											3.31	2.85	3.97	3.52	3.68	3.01	3.17	3.42	3.27	3.16																					
20.											3.08	2.99	3.57	3.38	3.70	3.02	2.81	2.53	3.15	2.92																					
21.											3.13	3.41	3.14	3.39	3.43	3.60	2.42	3.15	3.04	2.94																					
23.											3.05	3.23	3.42	2.86	3.31	3.56	3.67	3.44	3.65	2.80																					
May 1.											3.33	2.52	2.89	2.68	3.30	3.47	3.25	2.91	3.08	2.86																					
3.											3.42	2.92	2.93	3.60	3.35	3.05	2.83	3.07	2.97																						
6.											3.62	3.07	3.31	3.12	2.94	3.36	2.59	3.29	3.27	3.20																					
9.											2.82	3.21	3.08	2.86	2.86	2.94	2.84	3.24	3.19	3.11	2.87	3.22	3.03	3.04	2.72	3.10	3.05	2.65	2.51												
10.																					2.93	3.01	2.58	3.21	3.06	2.63	2.95	2.51	3.15												
12.											2.83	2.93																													
13.											3.10	2.48	2.99	2.92	3.39	3.45	3.46	2.89	2.91																						
16.											3.84	2.16	3.42	2.76	2.96	3.20	3.15	3.28	2.92	2.71	3.10	3.29	3.60		3.19	2.78	2.29	2.56	2.91												
18.											3.02	3.35	3.23	3.25	3.06	3.17	2.75	3.32	3.20	2.96	2.62	3.47	3.27	3.13	3.35	2.99															
22.											3.11	2.91	2.30	2.89	3.08	2.54	3.16	2.53	3.11	2.68	3.09	3.05	3.48	3.46	3.10	2.72	2.95	3.37	2.70												
23.											2.49	3.32	3.20	3.08	2.68	2.87	2.71	2.95	2.60	2.85	2.83	3.15	2.82	3.02	3.14	3.13	3.52	3.51	3.04												
28.											2.95	3.29	3.48	3.43	2.98	3.20	3.55	3.23	3.61	3.05	3.05	3.08	3.37	3.13	2.73	2.84	2.95	2.34	2.80												
29.											2.67	3.21	2.82	3.06	2.64	3.07	3.08	2.70	3.21	3.29	3.34	3.24	3.00	3.32	3.27	2.90	3.08	2.93	3.07												
30.											3.43	3.02	3.24	3.11	2.64	3.00	3.30	2.81	3.27	2.95	3.41	3.23	3.33	2.95	3.30	2.93	2.92	3.00	3.17												
June 7.											3.33	2.87	2.63	3.04	2.78	2.97	2.57	3.10	2.88	3.23	2.78	2.93	2.81	2.89	2.85	3.44	2.87	3.40	3.18												
8.											3.02	2.88	2.82	2.77	2.68	2.61	2.87	3.22	3.37	3.02	3.25	3.16	3.46	3.32	3.14	2.62	3.19	2.50	3.18												
9.											2.98	3.44	3.23	2.91	3.31	3.07	3.03	3.46	2.59	2.55		2.97	2.69	3.12	3.01	2.58	3.16	3.05	3.08												
11.											3.21	2.82	3.12	3.50	2.94	3.02	3.00	3.32	3.20	2.83	3.26	2.94	3.69	3.19	2.74	2.49	3.09	2.73	3.35												
14.											2.77	3.03	2.93	3.20	3.13	3.29	2.90	3.38		3.37																					
16.											3.26																														
23.											3.03	2.94	2.90	3.04	3.17	2.98	2.84	2.61	3.22	3.17																					
25.																					2.85	2.93	2.86	3.56	3.46	2.98	2.62	3.31	3.27												
28.												2.98	2.49	3.25	2.70	2.77																									
29.												3.09	2.77	2.88																											
July 9.																					3.46	2.97	2.76	2.87	3.12	3.32	2.92	3.05	2.65	2.87	2.71	2.56	2.80	2.69	2.78	3.25	2.83	2.76	2.94	3.09	
10.																					3.26	3.05	3.30	2.63	2.74	3.13	2.53	2.75	3.05												
12.																					2.98	3.07	2.90	2.78	3.40	3.09	3.07	2.78	3.00	2.91	3.23	2.51	3.15	3.25	3.13		2.70				
16.																					3.37	3.03	3.58	2.93			3.05	2.86	2.87	2.94	3.36	3.54	2.84	3.37	2.63	3.12	3.14	2.88	2.69	3.01	2.12
18.																					3.05	2.74	2.53	2.72	3.05	3.46	3.01	2.81	3.02	3.23	2.93	2.41	2.54	3.07	3.12	2.63	3.08	2.75	3.03	3.09	2.75
19.																					2.45	2.75	3.14	3.29	2.57	2.76	2.90	2.75	2.65	3.48	2.25	3.46	2.91	2.98	3.03	3.09	2.89	3.03	2.55	3.12	2.68
25.																					2.96	2.41	2.83	3.21	2.98	3.22	3.13	3.19	3.18	2.94	2.54	2.30	3.39		3.21	2.85	2.55	2.93	3.16	2.32	2.70
26.																					2.64		3.58	2.94	3.25	2.80	3.10	2.54	2.28		2.86	[4.35]	2.69	3.45	2.94	3.08	3.14	3.05	2.64	3.18	2.55
28.																					3.04	3.01	2.53	2.91	3.13	3.24	2.85	2.64	3.00	2.62	3.27	2.60	3.11	3.11	3.16	2.42	3.11	3.04	3.24	2.81	3.24
29.																					2.93			2.60	2.15	2.54	2.89	3.00	2.80	2.49	2.96	2.94	3.12	2.92	3.09	3.19	2.79	3.05	2.57	2.39	3.56
30.																					2.65	3.05	2.87	2.80	2.79	2.87	3.02	2.89	2.47												
31.																					2.60	2.64	2.63	2.77	2.35	2.87	3.17	2.99	2.86	2.96	3.12	2.92	2.96	2.17	3.10	2.78		3.11	3.14	2.58	2.60
Aug. 3.																					2.60	3.03	3.06	2.64	3.31	2.85	2.91	3.13	2.90												
5.																					2.66	3.01	2.55	2.73	2.59	2.63			2.91												
7.																					2.99	3.05	3.03	2.64	2.86	2.76	2.87	3.02	2.71	3.68	2.75	3.19	3.32	3.06	2.70	3.04		3.11			
8.																					2.91	3.07	2.44	2.74	2.88	3.21	3.31	3.06	2.96												
10.																					2.91	3.24	2.96	2.66	2.92	2.62	2.96	3.30	2.86	3.21	3.11	2.68	2.54	2.68	2.75	3.00	2.56	2.74	3.17	2.99	3.05
12.																					2.78	2.74	2.96	3.19	3.01	2.99	2.43	3.43	3.10												
13.																														2.70	2.78	2.97	3.61	2.51	2.84	3.10	3.02	3.05	3.30	3.11	3.08
15.																					3.42	3.00	3.06	2.58	2.75	3.01	2.60	2.75	2.90	3.00	3.02	2.20	3.03	3.09	3.03	2.45		3.26	2.98	2.47	2.53
18.																					2.86	2.63	2.60	2.82	2.90	2.98	3.03	3.07	3.07	2.84	2.89	3.19	2.66	2.86							
19.																						3.45	3.21	2.58	2.82	2.70	3.35	2.70	2.90	2.99	3.09	2.32	3.00	2.77	2.89	2.93	2.66	3.04	3.22	2.59	

Diagram Showing Variation of Latitude at South Bethlehem from 1894, January 19, to 1895, August 19.



ARTICLE IV.

A STUDY OF THE CHROMOSOMES OF THE GERM CELLS OF METAZOA.

Plates IV—VIII.

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Read January 18, 1901.

I. Introduction.

The present study is practically a continuation of previous work of mine upon spermatogenesis in the Arthropods. It was undertaken primarily to correct certain errors of interpretation and observation in my work on *Pentatoma* (*Euchistus*). But many morphological problems arose in connection with this reëxamination, such as the significance of the changes in the synapsis stage, the significance of the chromatin nucleoli, the reasons for a reduction division, the significance of the sequence of the stages of the germinal cycle, and the question as to why different species have different numbers of chromosomes. Thus my investigations given here are essentially on the history of the chromosomes during the germinal cycle.

It is impossible to answer these problems by an examination of a single species, and accordingly there are presented here the results of a comparative study of the spermatogenesis of some forty-two species of *Hemiptera heteroptera*, belonging to twelve different families. This comparative study has brought to light certain wholly unexpected phenomena, and none less anticipated than the discovery of four species with an uneven normal number of chromosomes; this discovery has furnished facts for explaining how the chromosomal numbers may change with the evolution of the species, and how the chromatin nucleoli may have originated. And only such a comparative study could furnish facts to show that in the synapsis stage bivalent chromosomes are formed by the union of paternal with maternal chromosomes—*i. e.*, that this is the stage of conjugation of the chromosomes. The comparative method in Cytology cannot be overestimated, hough of course careful detailed examinations of single objects should be carried on at the same time. For a single object is rarely capable of serving as the basis of explana-

tion of all the problems; an investigation of a number of forms always shows that some are more favorable than others for answering certain questions, and then there is the chance that a wholly unexpected discovery may be made that may have great significance. So the plea is made here for the comparative method in Cytology, and Cytology should not be ranked as a line of work separate from others—it is all Morphology in the broad sense of the term, and it only happens that in Cytology we use higher magnification powers of the microscope than in other lines. If one form shows phenomena that seem inexplicable after careful work, then the proper method, the one that would promise a surer reaching of results, is not to reëxamine this form again and again, but to compare other forms in the search for the explanation.

In the present paper the part containing the general conclusions may appear disproportionally great to the record of the observations. These observations are to great extent on the number and valence of the chromosomes and chromatin nucleoli from the time of the last generation of the spermatogonia up to the formation of the spermatids. But the determination of these numbers is very difficult; large numbers of sections have to be examined in order to find the necessary stages, and the number of the chromosomes of each stage have to be counted in a considerable number of cells of each species in order to insure accuracy. The counting has been done in all cases by selecting those cells in which the chromosomes are most loosely grouped, being sure at the same time that all the chromosomes are in the plane of the section, drawing the chromosomes carefully with the camera lucida, then counting their number on the drawings. This demands much patience and time, necessitating also constant reëxaminations and study of new material, though the results may be tabulated in a very small space. Of course the difficulties are most pronounced where the chromosomes are numerous and small.

The material was collected by me at two localities—in the vicinity of Philadelphia, Pennsylvania, and in the neighborhood of Wood's Holl, Massachusetts. Great care was taken to insure accurate identification of the species, and my specimens were directly compared by me with the collections in the museums of the Wagner Institute of Science and of the Academy of Natural Sciences of this city; these collections had been labeled by Dr. P. R. Uhler, of Baltimore, our foremost American authority on this group of Insects; and I must also acknowledge my indebtedness to Dr. Uhler for kindly identifying a number of species which were not represented in the collections just mentioned. To my friend, Mr. C. W. Johnson, curator of the Wagner Institute, my thanks are also due for aid in identification. The differences of the spermatogenetic phenomena of different species shows how important it is to secure accurate identification.

The testes were removed as rapidly as possible from the living animals and immediately placed in the fixing fluids, Flemming's chromo-aceto-osmic acid mixture (the

stronger solution), Hermann's chromo-aceto-platinic chloride mixture, and a piero-acetic mixture recommended by Prof. Conklin (100 parts saturated aqueous solution of picric acid, 100 parts distilled water, 6 parts glacial acetic acid) being used. Of these the mixtures of Flemming and Hermann proved the best for the chromosomal structures, for the piero-acetic mixture, while giving an excellent preservation of the actromatic spindle structures, swells the chromosomes very considerably so that on pole views of monaster stages they generally appear closely apposed to one another, which makes it difficult to count them. Where the species is small it is necessary to remove the testes in the fixative under a dissecting microscope. The sections were stained either by the iron-hæmatoxylin method of Heidenhain or by the saffranine-gentian violet method of Hermann.

II. Observations.

PENTATOMIDÆ.

1. *Euchistus variolarius* Pal. Beauv.

This is the species the spermatogenesis of which I described under the name of "*Pentatoma*" in a former paper (1898); twenty-eight testes were studied from adult individuals of all seasons except the winter months.

In my former paper (*l. c.*) I did not find chromatin nucleoli in the spermatogonia; I concluded that there was no stage of longitudinal splitting of the chromosomes during the growth period, and I concluded that the second maturation division was a reduction mitosis like the first. Shortly afterward appeared the papers by Paulmier (1898, 1899) on the spermatogenesis of *Anasa tristis*, wherein he showed that there are two chromatin nucleoli (his "small chromosomes") in the spermatogonia, and that these unite in the spermatocytes to form one bivalent one; that the chromosomes undergo a longitudinal splitting in the growth period, and that the second maturation division is equational. In those points wherein I differed from Paulmier, I find that Paulmier is correct, and that I gave a wrong interpretation to the phenomena in *Euchistus*. I find nothing to correct in the matter of the other points described in my earlier account, and here give briefly merely the necessary emendations to my former paper.

Spermatogonia.—In the resting spermatogonium there are in the nucleus beside the true nucleolus (of which there may be more than one) two small chromatin nucleoli of rounded form (Plate I, Fig. 1, *N. 2*). With the saffranine-gentian violet stain of Hermann, when properly used, these stain bright red, the true nucleolus a faint bluish, the chromatin proper a deep violet; careful staining and thin sections are necessary to show them plainly. Sometimes one or both of them are attached to a true nucleolus. In the prophases of mitosis the chromatin nucleoli are easily recognizable by being much smaller

and more spherical than the chromosomes. In the monaster stage, in favorable cases where the chromatic elements are not too densely arranged, are seen fourteen larger elements, the chromosomes proper, and two smaller ones regularly rounded in form, which are the chromatin nucleoli (Figs. 2, 3, *N. 2*). Sometimes the chromosomes are rounded, but since they frequently appear slightly elongate on pole view of the spindle, their division in metakinesis must be an equational one. In the metakinesis all sixteen elements, the fourteen chromosomes and the two chromatin nucleoli, are divided, so that each daughter cell (first spermatocyte) receives sixteen elements.

Thus there are two chromatin nucleoli in the spermatogonia, and the chromatin nucleolus of the spermatocystes is not, as I had previously described, formed by a modification of one of the fourteen chromosomes of the spermatocytes, but is derived from the two of the spermatogonia. My error was perhaps excusable, since in restudying the preparations which were used for my former paper I find that they are not suitably stained to show the chromatin nucleoli in the spermatogonia.

Growth period of the spermatocytes (anaphases of the last spermatogonic division, synapsis, postsynapsis, telophase and rest).—The fourteen chromosomes in each daughter cell (first spermatocyte) pass toward the pole of the spindle and become irregular in contour and form. Then each becomes longitudinally split (Figs. 4–11). This splitting cannot be clearly seen in all preparations, and is by no means as clear as in *Anasa* and certain other *Hemiptera;* the preparations of my former paper were too deeply stained to show it. The split commences in the early synapsis stage (Fig. 4) and is most marked in the postsynapsis (Fig. 9), and is clearly a single longitudinal split. Never do the split halves separate widely from one another, as Paulmier found for *Anasa,* but always appear to remain close together and approximately parallel; at the most there is a divergence only at the ends of the chromosomes. On deep staining the split may be easily overlooked. The two chromatin nucleoli do not become loose in texture, retain their characteristic red stain with saffranine, and join together in the early synapsis to form one dumbbell-shaped (bivalent) one (*N. 2,* Figs. 4, 5, 8, 10); they do not become longitudinally split like the chromosomes proper. In the early synapsis they are frequently very irregular in form, as I showed in my previous paper, but the apparent fragmentation of them which I then described—a fragmentation of a single long one into two—is not a fragmentation at all, but a stage before the two have joined to form one bivalent one.

Reduction in number of the chromosomes.—In my earlier paper I showed that the number of chromosomes is reduced one-half during the synapsis period—*i. e.,* long before the maturation divisions. I then considered it probable that the reduction in number was effected by a union of chromosomes end to end, but was unable to prove this point. Since then I have been able to demonstrate that this numerical reduction is effected in

the synapsis by the union into seven pairs of the fourteen chromosomes, each of the seven bivalent chromosomes (pairs) being composed of two univalent chromosomes joined end to end (Figs. 5–11). Where the ends of two univalent chromosomes come together is seen a connecting band of linin; each bivalent chromosome during the synapsis and postsynapsis is U- or V-shaped, and the bend or angle of the U or V marks the point of union of two univalent chromosomes; the arms of the U or V are longitudinally split. In each bivalent chromosome only one end of each univalent chromosome is thus closely connected with one end of the other, the opposite ends of the univalent chromosomes having no such linin connections. It has been already mentioned that the two chromatin nucleoli come together likewise to form one bivalent one, and it can be seen that they are connected by a band of linin.

In a paper on the spermatogenesis of *Peripatus* (1901) I showed that it is a particular end of one univalent chromosome which unites with a particular end of another; these ends are the ones which point nearest to the pole of the spindle in the anaphase of the last spermatogonic mitosis, the "central ends," as I have called them, in distinction to the opposite or "distal ends." In *Euchistus*, on the contrary, I am unable to determine positively whether it is similar ends of chromosomes which unite, because in this form the chromosomes have a much more irregular position within the nucleus; the polarity of the nucleus is not so well marked as in *Peripatus*. In the cell body the polarity is as in *Peripatus:* that pole with the greatest amount of cytoplasm and containing the idiozome mass is the distal pole (the one which in the dyaster stage of the last spermatogonic division was in the equator of the cell). This polarity of the cell body is shown in Figs. 4, 5 and 8; I figured it also in a number of cases in my previous paper, but then erroneously supposed the idiozome mass to occupy that point where the spindle pole had previously been, whereas I am now able to determine positively that this pole is situated directly opposite, namely, where the least amount of cytoplasm is situated. Now it would appear in *Euchistus*, though not nearly so regularly as in *Peripatus*, that it is the openings of the U- or V-shaped bivalent chromosomes that are directed toward the distal pole of the cell body (toward the pole where the idiozome mass is placed). Figs. 4, 5 and 8 show this for certain of the chromosomes, while other ones (as two in Fig. 5) may have their openings in opposite directions. Thus in *Euchistus* there is more irregularity in the positions of the axes of the chromosomes, so that I have been unable to determine whether it is, as in *Peripatus*, only particular ends of the univalent chromosomes which unite with particular ends of others.

Throughout the growth period can be seen two kinds of linin threads: (1) thicker threads which connect the ends of the chromosomes, and (2) more delicate ones which join chromatin granules with the nuclear membrane. Apparently, as I have shown for

Peripatus, the former, together with the linin contained in the chromosomes (axial threads), together constitute a single continuous linin spirem in the nucleus.

Rest stage of the spermatocytes.—A rest stage in the growth period preceding the prophases of the maturation mitoses is well marked in *Euchistus* (Fig. 12 and Figs. 95–100 of my preceding paper); though I can confirm Paulmier's observation that such a stage does not occur in *Anasa*. It is characterized by a huge true nucleolus, by a rather diffuse and scattered distribution of the chromatin so that chromosomal boundaries are practically indistinguishable, and by the diffuse arrangement of a great amount of idiozome substance all around the nucleus, so that an idiozome mass with sharp outlines is not present; the idiozome mass in the synapsis stage (Figs. 4, 5, 8), on the contrary, had a sharp and distinct outline. The bivalent chromatin nucleolus has now become nearly rounded in form, rarely showed a dumbbell shape, so that its component parts are very closely apposed. It lies peripheral, in contact with the nuclear membrane, while the true nucleolus lies nearer the centre of the nucleus. Sometimes a much smaller rounded body, staining like the chromatin nucleolus, is also found in the nucleus, but what its origin is I have not been able to determine, for I have not found it in the spermatogonia, though it might well escape detection there on account of its small size.

As to the terminology adopted by me in my former paper (1898) for the series of stages of the growth period, which has been criticised by McClung (1900), the term "metaphase" was, I grant, used by me incorrectly, for I used it for the commencement of the anaphase, whereas it is really Strasburger's stage comparable to Flemming's "metakinesis." However, the exact use of these terms was explained by me (1898, p. 20). In the stages leading up to the resting spermatocyte I distinguished "early anaphase," "synapsis," "postsynapsis," and "telophase" as easily recognizable stages in the growth period of *Euchistus* which need to be characterized by terms for purposes of description. McClung (*l. c.*) considers the appearances of the synapsis stage as artefacts; it is hardly necessary to reply to this criticism, since in all *Metozoa* where the spermatogenesis has been carefully examined, with the exception of certain *Amphibia*, the dense massing of the chromosomes in the synapsis stage has been shown to be a perfectly normal phenomenon. As to my use of "telaphase," Heidenhain's (1894, p. 524) definition is: "Unter dem Namen Telokinesis beschreibe ich gewisse Bewegungen des Kerns und des Mikrocentrums, welche gegen das Ende der Mitose hin stattfinden. . . . Die zugehörigen Stadien der Mitose bezeichne ich als Telophasen." Since Heidenhain employed it for the stage just preceding rest in leucocytes, I was warranted in using it for the stage just before the rest stage in the spermatocytes of *Euchistus*. It must be borne in mind, in the description of the changes of the growth period of the germ cells, that a peculiar stage, the synapsis, occurs, not found elsewhere in mitosis, and that this stage modifies to greater or

less extent, according to the object, the stages which precede and those which succeed. It results from this that the stages of mitosis of the growth period cannot be exactly compared with those of other cells, and hence the terms "anaphase" and "telophase" can here have a significance only approximately similar to that of other mitoses.

The maturation divisions.—In the early prophases the longitudinal splitting of the chromosomes is well marked, clearer than in preceding stages (Figs. 13, 14). Each chromosome is, as before the rest stage, clearly bivalent, formed of two longitudinally split univalent chromosomes joined so as to make an angle together (Figs. 13–15), and at the bend of the angle is a connecting linin thread. These forms of the bivalent chromosomes were clearly figured in my earlier paper, except that then I had overlooked the longitudinal split. The chromosomes gradually become closer, shorter, with smoother outlines, the longitudinal split gradually becomes hidden, and the definitive chromosome with the form of a dumbbell results (Figs. 16–18). In the definitive chromosome there is usually no trace of the longitudinal split, except occasionally as a slight indentation at the free end of a univalent component. The constriction of the dumbbell marks the point of union of two univalent chromosomes, which is effected by a linin band which generally never becomes quite hidden.

In the late prophases, just before the disappearance of the nuclear membrane, and when the centrosome pairs have reached opposite poles of the nuclear surface, a remarkable condition of the linin threads is found (Fig. 17); it was also shown in Figs. 152 and 153 of my earlier paper. The linin, previously in the form of fibres or strands, now takes the form of chains of small globules—quite as Van Beneden (1883) had figured for *Ascaris*. I cannot explain this condition, but I have found it always at this stage, and at this stage only.

In the first maturation division there are seven bivalent chromosomes and one bivalent chromatin nucleolus, and all these elements are divided transversely in metakinesis, being placed in the monaster stage so that their constrictions lie in the plane of the equator. Fig. 18 shows a monaster stage with all these elements on lateral view, Fig. 19 on pole view; this stage was accurately described by me in my former paper, so that I have no additions to make to that description. Whole univalent chromosomes are separated in the ensuing metakinesis, and the univalent components of the chromatin nucleolus are also separated.

When the daughter chromosomes separate in the anaphase a constriction or indentation appears on them (Figs. 193–201 of my preceding paper). This I am now able to prove, in agreement with Paulmier's observations on *Anasa*, is the reappearance of the longitudinal split; this indentation or constriction becomes placed in the equatorial plane of the monaster stage of the second maturation division, so that the latter division divides

the chromosomes equatorially. In the anaphase of the first maturation division the constriction of the chromosomes generally has the appearance shown in Fig. 195 of my former paper; while Fig. 196, which I then considered to represent the typical condition, I now, from the study of more abundant material, find to be an unusual condition. That is to say, the appearance of the chromosomes shown in Fig. 196 of my preceding paper is really atypical, since in this case their constrictions appear at right angles to the long axis of the spindle, whereas in most other cases the planes of these constrictions coincide with planes passing through the long axis of the spindle. In this second maturation division the chromatin nucleolus is not always divided.

2. *Euchistus tristigmus* Say

Four testes of this species were studied.

In the rest stage of the spermatogonium there are two small chromatin nucleoli, generally attached to the surface of the true nucleolus.

In the spermatogonic mitosis there are fourteen chromatin segments in the equatorial plate (Pl. I, Fig. 20); the twelve larger, usually somewhat elongate ones are chromosomes, and the two smallest, rounded ones are chromatin nucleoli. All these elements are halved in metakinesis.

In the synapsis stage the twelve chromosomes unite to form six bivalent chromosomes. The two chromatin nucleoli sometimes unite to form a bivalent one, which is clearly dumbbell-shaped in earlier stages, but in the resting spermatocyte becomes rounded and has a peripheral position (Fig. 22); or quite as frequently they remain separate from one another during the growth period, and are seen to be of unequal volumes (Fig. 21). The chromatin nucleoli in the growth period are rarely attached to the true nucleolus.

In the first maturation division there are always six clearly bivalent, dumbbell-shaped chromosomes and either one dumbbell-shaped bivalent chromatin nucleolus or, apparently more frequently, two univalent chromatin nucleoli of more or less rounded form and different volume (lateral view shown in Fig. 25, N. 2). Accordingly, on pole views of the monaster stage there are seen either seven chromatin elements (Fig. 24), which are six bivalent chromosomes and one bivalent chromatin nucleolus, or there are eight, namely, six bivalent chromosomes and two univalent chromatin nucleoli (Fig. 23: in this figure one of the chromatin nucleoli can be distinguished by its smaller size, but which of the remaining seven elements is the other chromatin nucleolus is not easily discernible on pole views, since the larger of the two chromatin nucleoli has a diameter equal to that of one of the smaller chromosomes).

All the six chromosomes are halved (by a reduction division) in metakinesis, so that

in the monaster stage of the second division there are six univalent chromosomes, the constrictions of which represent the reappearance of the longitudinal split (Fig. 26); there are also in the same equatorial plate two non-constricted bodies of different volumes which are not joined together. These are the chromatin nucleoli, which are regularly halved in the first maturation metakinesis—that is, they are the halves of univalent ones. Thus the bodies marked *N. 2* in Fig. 26 are the halves of those similarly marked in Fig. 25.

The second maturation division is equatorial, and the spermatid receives six chromosomes, arranged in an outer circle around a single central chromatin nucleolus. Accordingly in this second division one chromatin nucleolus passes undivided into one daughter cell (spermatid), the other undivided into the other daughter cell.

As in *Euchistus variolarius*, two follicles of the testis contain spermatocytes of a much larger size than those in the four other follicles.

3. *Podisus spinosus* Dall.

Five testes of this species were studied.

In the spermatogonic rest stage there are two small chromatin nucleoli, of more or less rounded form, attached to the surface of a true nucleolus.

In the spermatogonic monaster there are sixteen chromatin segments (Pl. I, Fig. 27), two of which probably correspond to the chromatin nucleoli of the previous rest stage.

In the synapsis the fourteen chromosomes unite to form seven bivalent chromosomes. The two chromatin nucleoli also come together to make one bivalent one; in the growth period of the spermatocytes (Fig. 28) the chromatin nucleolus lies close to the nuclear membrane, and to its inner surface the true nucleolus is regularly attached.

In the first maturation monaster there are eight chromatin elements, namely, seven chromosomes and one chromatin nucleolus, all bivalent and dumbbell-shaped on lateral view; the chromatin nucleolus has about the same volume as the smaller ones of the chromosomes, and so cannot be distinguished from them with certainty.

4. *Mormidea lugens* Fabr.

Five testes were studied.

In the rest stage of the spermatogonia there are two chromatin nucleoli (Pl. I, Fig. 30, *N. 2*), which may be equal or unequal in size; they may be attached together, which is apparently the general rule, or may be separated, and one or both of them may be apposed to the true nucleolus.

In the spermatogonic monaster there are sixteen chromatin segments; two of these

which are smaller than the others and more rounded are the chromatin nucleoli (Fig. 31, *N. 2*).

In the synapsis the fourteen chromosomes unite to form seven bivalent ones, and the two chromatin nucleoli to form one bivalent chromatin nucleolus. The latter is peripherally placed in the nucleus, and not attached to the true nucleolus (Fig. 32).

In a pole view of the monaster stage of the first maturation division are found eight chromatin elements (Fig. 33); lateral view shows all are bivalent and dumbbell-shaped, seven are chromosomes, and one easily recognizable by its much smaller size in the chromatin nucleolus (Fig. 33, *N. 2*).

5. *Peribalus limbolaris* Stal.

Two testes of this species were studied.

In the rest stage (Pl. I, Fig. 34) and prophases of the spermatogonia are found two chromatin nucleoli of unequal size (*N. 2*), and sometimes apparently three; they are generally not in mutual contact, though they are often apposed to the true nucleoli, of which there are frequently two or three.

In the spermatogonic monaster (Fig. 35) are sixteen chromatin segments, of which the two smallest, rounded ones are the chromatin nucleoli; the fourteen chromosomes are notably elongated.

In the synapsis the fourteen chromosomes unite to form seven bivalent ones, and the two chromatin nucleoli to form one bivalent chromatin nucleolus; in the rest stage of the spermatocytes (Fig. 36) the chromatin nucleolus (*N. 2*) is usually rounded and peripherally placed, and generally unattached to the relatively very large true nucleolus (sometimes there are two true nucleoli, as in Fig. 36, rarely three). In the rest stage of the spermatocytes there is a smaller chromatin nucleolus in addition to the larger one already described, and this smaller may correspond to the third of the chromatin nucleoli found sometimes in the rest stage of the spermatogonia.

In the monaster stage of the first maturation division there are eight chromatin segments (Fig. 37), namely, seven bivalent, dumbbell-shaped chromosomes and one much smaller bivalent, dumbbell-shaped chromatin nucleolus.

6. *Cosmopepla carnifex* Fabr.

Five testes of this species were studied.

In the monaster stage of the spermatogonia (Pl. I, Fig. 38) are found eighteen chromatin segments; two of these are smaller than the others, and so by analogy with other species of this family probably represent chromatin nucleoli (*N. 2*, Fig. 38); the sixteen other segments are then true chromosomes.

In the synapsis stage of the growth period the sixteen chromosomes unite to form eight bivalent chromosomes, and the two chromatin nucleoli to form one bivalent chromatin nucleolus. The latter is, in the rest stage of the spermatocytes, rounded and peripheral in position, and is not attached to the larger true nucleolus (Fig. 39); both the nucleolus and the chromatin nucleolus may contain a large, clear vacuole, which in the former is excentric.

Pole views of the monaster stage of the first maturation division show nine chromatin elements (Fig. 41), and lateral views (Fig. 40) of the same stage show that all are bivalent and dumbbell-shaped. The smallest of these elements is the chromatin nucleolus (*N. 2*).

7. *Nezara hilaris* Say

Five testes of this form were studied.

There are in the rest stage and early prophases of the spermatogonia two chromatin nucleoli, which are comparatively large and usually more or less unequal in size (Pl. I, Figs. 42, 43, *N. 2*). They are generally peripheral in position and in mutual contact, but usually are not apposed to the true nucleolus (*N*).

In the spermatogonic monaster there are sixteen chromatin segments (Fig. 44), of which two can be always recognized by their small size and rounded form as the chromatin nucleoli; the fourteen chromosomes are generally elongated.

In the synapsis the two chromatin nucleoli unite to form one bivalent one, and apparently also the fourteen chromosomes join to make seven bivalent chromosomes, but I cannot state this with certainty. In the telophase of the spermatocytes (Fig. 45), the chromatin nucleolus (*N. 2*) is peripherally placed and clearly bivalent, and usually not in connection with the very large true nucleolus (*N*), which is also peripheral.

In the testes examined (all from individuals secured in the month of September) were stages only from the resting spermatogonia to the telophase of the spermatocytes; all later stages in the spermatogenesis were absent, so that the number of the chromosomes in the maturation divisions could not be determined.

The longitudinal split in the chromosomes during the growth period is unusually distinct in this species.

8. *Brochymena* sp.

Three testes of this species were studied.

In the rest stage of the spermatogonia (Pl. I, Fig. 46) are two small chromatin nucleoli (*N. 2*), which are peripheral in position, of nearly equal size, generally mutually apposed, and seldom attached to the true nucleolus.

In the spermatogonic monaster stage (Pl. I, Fig. 47) are sixteen chromatin segments, of which two are smaller and rounded and are the chromatin nucleoli.

In the synapsis stage the fourteen chromosomes unite to form seven bivalent ones, and the two chromatin nucleoli to form one bivalent chromatin nucleolus. The latter in the stages following the synapsis is rounded and peripheral in position (*N. 2*, Fig. 48, Pl. II), and only occasionally attached to the true nucleolus (*N*).

Pole views of the first maturation monaster (Pl. II, Fig. 49) show eight chromatin segments, of which one easily distinguishable from the others by its smaller size is the chromatin nucleolus (*N. 2*). Lateral views of this stage show that all eight of these elements are bivalent and dumbbell-shaped.

9. *Perillus confluens* H.–S.

Two testes of this species were examined.

The rest stage of the spermatogonia (Pl. II, Fig. 50) shows two small, rounded chromatin nucleoli of unequal size, which are always attached together, and may be either close to the nuclear membrane or apposed to the surface of a true nucleolus (*N*).

In the monaster stage of the spermatogonic divisions are sixteen chromatin segments (Fig. 51). The fourteen largest are chromosomes, the two smallest are chromatin nucleoli (*N. 2*); the latter are more minute than in the corresponding stage of any other Pentatomid examined by me, and on account of their small size cannot always be seen (*i. e.*, in cases where they are closely apposed to the chromosomes).

In the synapsis stage the fourteen chromosomes unite to form seven bivalent ones and the two chromatin nucleoli to make one bivalent chromatin nucleolus. The latter is dumbbell-shaped in the earlier stages of the growth period, but in the rest stage (*N. 2*, Fig. 52) becomes oval in outline, and it is then attached to the surface of the larger true nucleolus (*N. 2*), the two occupying a more or less central position within the nucleus.

Pole views of the monaster stage of the first maturation division show eight chromatin segments of varying diameter (Fig. 53); one of these, probably the smallest, is the chromatin nucleolus; lateral views show that all these elements are bivalent and dumbbell-shaped.

10. *Cœnus delius* Say

Three testes of this species were studied.

In the rest stage of the spermatogonia there are two chromatin nucleoli with irregular outlines (Pl. II, Fig. 54, *N. 2*), and they are situated usually close together.

In the spermatogonic monaster stage (Fig. 55) there are fourteen chromatin segments, the two smallest of which are probably the chromatin nucleoli (*N. 2*), leaving twelve chromosomes.

In the synapsis stage the twelve chromosomes unite to form six bivalent ones. The

two chromatin nucleoli found in the spermatogonia also unite to form one bivalent chromatin nucleolus; this is clearly bilobed in the earlier stages, but more rounded in the later stages of the growth period of the spermatocytes (the larger of the bodies designated *N. 2* in Figs. 57, 58, 63); there is attached to it usually a small true nucleolus (Fig. 58). Besides this large bivalent chromatin nucleolus there is also found in the spermatocytes, most clearly seen in the rest stage, another much smaller one, of rounded form (the smaller of the bodies marked *N. 2* in Figs. 57, 58, 63); this is almost always apposed to one of the true nucleoli (*N*), of which there are generally two large ones besides the small one attached to the large chromatin nucleolus; quite frequently the small chromatin nucleolus lies between the large one and a large true nucleolus (Fig. 63). This small chromatin nucleolus is difficult to see in the synapsis stage, when the chromosomes stain deeply, and since I was also unable to find it in the monaster stage of the spermatogonia, I could not determine whether it is bivalent or univalent or what its earlier history is. It might well be present, however, in the spermatogonia, but be there so minute as to escape detection.

Pole views of the monaster stage of the first maturation division show sometimes only seven chromatin segments (Fig. 62), and then these are six bivalent chromosomes and the large bivalent chromatin nucleolus; or they show eight segments (Figs. 59, 60), of which the smallest is the small chromatin nucleolus of the growth period. That is to say, in the equatorial plate there are always six bivalent chromosomes and the large bivalent chromatin nucleolus, while the small chromatin nucleolus may be present or may be absent. The lateral view of this stage given here (Fig. 61) shows seven large dumb-bell-shaped elements, ot which six are chromosomes and one the bivalent chromatin nucleolus—though which one it would be hard to say, for all of these elements are of approximately equal size and similar form; while the smallest, eighth, element marked *N. 2* in this figure is the small chromatin nucleolus. When the latter persists into this stage it appears to be halved in the following metakinesis.

II. *Trichopepla semivittata* Say

Four testes of this species were studied.

In the nucleus of the resting spermatogonium are seen clearly two rounded chromatin nucleoli (*N. 2*, Fig. 64, Pl. II), of different volumes, one or both frequently apposed to a larger true nucleolus (*N*).

In the monaster stage of the spermatogonia are found sixteen chromatin segments, of which fourteen are elongate chromosomes, and two which are smaller and rounded are the chromatin nucleoli (*N. 2*, Fig. 65), which here, as in the preceding rest stage, are unequal in size.

In the following synapsis stage the fourteen chromosomes join to form seven bivalent ones. The two chromatin nucleoli likewise unite to form one bivalent one, of which the two components are unequal in size (Fig. 66, *N. 2*). In the telophase and rest stage of the spermatocytes the chromatin nucleolus loses its earlier bipartite form and becomes rounded (the larger of the bodies marked *N. 2* in Fig. 67), and only occasionally is it apposed to the larger true nucleolus (*N*). Sometimes the two chromatin nucleoli derived from the spermatogonia do not unite together, but remain separated. During the growth period, its later stages at least, can be seen in each nucleus three or four much smaller, rounded bodies, which stain like the chromatin nucleoli; some of them are often attached to the surface of the true nucleolus (Fig. 67, the three smaller bodies designated *N. 2*). There are certainly three of them and in some nuclei apparently four. I was unable to determine with certainty these small chromatin nucleoli in the rest and division stages of the spermatogonia, though they might well be present there, but escape observation on account of their minuteness.

The monaster stage of the first maturation division (Figs. 68, 69) shows eight larger, bivalent, dumbbell-shaped chromatin segments, of which seven are chromosomes and one the large chromatin nucleolus (*N. 2* of the figures). Of the seven chromosomes one is always longer and more voluminous than the others (Figs. 68, 69), and is probably the derivative of the two largest chromosomes found in the spermatogonic divisions (Fig. 65). Besides these eight large elements of the monaster stage of the reduction division there may be seen on pole view usually one (Fig. 68), sometimes two much smaller granules, which evidently represent the small chromatin nucleoli found in the growth period.

SCUTELLARIIDÆ.

12. *Eurygaster alternatus* Say

Three testes of this form were studied from individuals taken in July and August. Each testis was filled with spermatocytes and spermatids, but contained no spermatogonia.

In the spermatocyte in the rest stage one bilobed and hence probably bivalent chromatin nucleolus (*N. 2*, Fig. 70, Pl. II), which is peripheral in position and separated from the usually smaller true nucleolus (*N*). Sometimes the two components of this chromatin nucleolus do not join together in the synapsis but remain separated through the growth period.

In the monaster stage of the first maturation division (Fig. 71, pole view) are found seven dumbbell-shaped (and hence probably bivalent) chromatin segments, of which the smallest is undoubtedly the chromatin nucleolus (*N. 2*), so that here there would be six bivalent chromosomes.

COREIDÆ.

13. *Anasa tristis* De G.

Twenty-one testes of this species were studied.

In regard to the chromosomal numbers my observations confirm those of Paulmier.

In the rest stage of the spermatogonium (Pl. II, Figs. 72, 73) there are two chromatin nucleoli (*N. 2*), which are much smaller than the true nucleoli (*N*) to which they are generally apposed. They have definite irregularly rounded or oval outlines as examined with Hermann's saffranine-gentian violet stain, and are not "hazy" or "indefinite" as Paulmier (1899) described. Both may be attached to the same nucleolus, or they may be joined to separate nucleoli. Sometimes each one may separate into two pieces (as is the case with one in Fig. 72). They are best seen on iron hæmatoxylin preparations so strongly destained that the chromatin reticulum does not appear.

In the monaster stage of the spermatogonia (Fig. 74) are twenty-two chromatin segments, namely, twenty larger chromosomes and two much smaller chromatin nucleoli (*N. 2*).

In the synapsis stage the twenty chromosomes unite to form ten bivalent ones, and the two chromatin nucleoli to form one bivalent one. The latter is clearly bipartite in the synapsis, but later shows an oval outline (Fig. 75); it is peripheral in position, often contains a central clearer vacuole as in the *Pentatomidæ*, and is as a rule separated from the true nucleolus (*N*).

In the monaster stage of the first maturation division (pole view, Fig. 76) are found eleven bivalent, dumbbell-shaped chromatin segments, of which the central, smallest one is the chromatin nucleolus (*N. 2*). I am able to confirm Paulmier's (1899) account of the two maturation divisions.

14. *Anasa armigera* Say

One testis of this species was studied.

The spermatogenesis seems to be very similar to that of the preceding species, but as I had no preparation stained with saffranine-gentian violet I was unable to determine the relations of the chromatin nucleoli in the rest stage of the spermatogonia.

Fig. 77, Pl. II, shows a pole view of a monaster stage of the spermatogonia, with twenty chromosomes and two chromatin nucleoli (*N. 2*); it is very similar to the corresponding stage in *Anasa tristis* (Fig. 74).

In the synapsis are formed ten bivalent chromosomes and one bivalent chromatin nucleolus.

In the monaster of the first maturation division (Fig. 78) are ten bivalent chromo-

somes and one bivalent chromatin nucleolus; Fig. 78 is a pole view, but in it those elements which appear dumbbell-shaped are seen from the side.

15. *Anasa* sp.

Of this undetermined species, which was collected for me at Berryessa in California I examined nine testes.

The resting spermatogonium shows two chromatin nucleoli (Pl. II, Fig. 79, *N. 2*) which are comparatively large and rather loose in texture, generally irregular in outline, occasionally attached to the true nucleolus (*N*), and more or less central in position.

In the monaster stage of the spermatogonia (Fig. 80) are twenty-two chromatin segments, namely, twenty larger chromosomes and two smaller chromatin nucleoli (*N. 2*).

In the synapsis the chromosomes unite to form ten bivalent ones, and the chromatin nucleoli to form one bivalent one. In the rest stage of the spermatocytes (Fig. 81) the chromatin nucleolus (*N. 2*) is seen to be somewhat elongate in form, is peripheral in position, and not attached to the true nucleolus (*N*).

In the monaster stage of the first maturation division are eleven bivalent elements, of which the smallest is the chromatin nucleolus (*N. 2*, Fig. 82); in this figure we do not have strictly pole views of all the chromosomes.

Fig. 83 shows four of the bivalent chromosomes on lateral view, in a paratongential section of a cell in the stage of the first maturation monaster. It is given here because it is the clearest case I have noticed in any Hemipteron of the quadripartite nature of these chromosomes, for while the transverse split may generally be seen at this stage, the longitudinal split is generally hidden. The poles of the spindle (not in the plane of this section, but seen in the next one to it) are situated at the upper and lower portions of the figure respectively; and it is hardly necessary to add that the first maturation division coincides with the plane of the transverse split, the second with the plane of the longitudinal split.

16. *Metapodius terminalis* Dall.

Eleven testes were studied of this species, which is very favorable on account of the large size of the cells; one should examine testes from individuals taken in June or early July, before the time of copulation.

In the rest stage of the spermatogonia (Pl. II, Fig. 84) are two chromatin nucleoli (*N. 2*) of very small size and smooth outlines, generally close together on the surface of a true nucleolus (*N*).

In the spermatogonic monaster (Fig. 85) are twenty-two chromatin segments, of which the two smallest are chromatin nucleoli (*N. 2*) and easily recognizable,

In the synapsis the twenty chromosomes unite to form ten bivalent ones, and the two chromatin nucleoli to form one bivalent one. The latter is in later stages of the growth period bilobed (*N. 2*, Fig. 86), is peripheral in position and not opposed to the larger true nucleolus (*N*).

In the monaster stage of the first maturation division are eleven chromatin segments (Fig. 87), of which the smallest, centrally placed one is the chromatin nucleolus (*N. 2*); all these elements are bivalent and on lateral view they all show the dumbbell-shape.

17. *Chariesterus antennator* Fabr.

Two testes of .this form were examined.

In the rest stage of the spermatogonia I could not be certain of the presence of chromatin nucleoli, for my preparations were not very well stained to demonstrate them. There were also no spermatogonic monasters favorable enough for determining the number of chromosomes.

In the synapsis stage there is a bivalent chromatin nucleolus, but sometimes its component parts are widely separated.

In the telophase of the spermatocytes (Pl. II, Fig. 88) the chromatin nucleolus (*N. 2*) is peripheral in position, sometimes its two univalent components still separated (but that is not the case in Fig. 88). The true nucleolus (*N*) is sometimes central, sometimes peripheral in position, and occasionally it is apposed to the chromatin nucleolus.

In the monaster of the first maturation division (Fig. 89, lateral view; Fig. 90, pole view) are found thirteen chromatin segments, of which the smallest, centrally placed one is the bivalent chromatin nucleolus (*N. 2*). Of the twelve chromosomes at least eleven would seem to be bivalent (having the characteristic dumbbell-shape); but in the lateral view here given (Fig. 89), it will be noted that the chromosome nearest the left-hand side does not appear dumbbell-shaped. This may be a bivalent one seen obliquely, or it may be a univalent one; which is the case I cannot determine, since there were few satisfactory lateral views on the preparations and since the number of chromosomes in the spermatogonia could not be determined.

18. *Alydus pilosulus* H. S.

Four testes of this species were studied.

The chromatin nucleoli in the rest stage of the spermatogonia (*N. 2*, Fig. 91, Pl. II) are two in number and rounded; they are very small, usually close together, and may be or not be attached to the true nucleolus (*N*).

In the spermatogonic monaster stage (Fig. 92) are fourteen chromatin segments, two

of which, easily distinguishable from the others by their small size, are chromatin nucleoli (*N. 2*).

In the synapsis stage the twelve chromosomes unite to form six bivalent ones, and the two chromatin nucleoli to form one bivalent one. In the late stages of the growth period (Figs. 93, 94) the chromatin nucleolus (*N. 2*) is rounded and peripheral in position, and usually apposed to the true nucleolus; even when they are separated the latter is usually peripheral (*N*, Fig. 94)—an unusual position for it in spermatocytes of *Hemiptera*.

In the monaster stage of the first maturation division (Fig. 95) are seven elements, namely, six bivalent chromosomes and one bivalent chromatin nucleolus (the smallest of the seven elements, *N. 2*); all these are dumbbell-shaped on lateral view, and though Fig. 95 is a pole view of the spindle two of its chromosomes are seen from the side.

19. *Alydus eurinus* Say

One testis of this species was studied.

In the rest stage of the spermatogonia I could not determine chromatin nucleoli, probably on account of their small size.

Numerous monaster stages of spermatogonia were examined, and all showed thirteen chromatin elements (Pl. III, Fig. 96); two of these which are readily recognizable from the others by their minute size are chromatin nucleoli (the two small granules shown in Fig. 96); the eleven large elements are chromosomes, and have mostly an elongated form.

In the synapsis the two chromatin nucleoli unite to form one bivalent one, which in the telophase of the spermatocytes (*N. 2*, Fig. 97) is relatively small, peripheral in position, and quite frequently apposed to the larger true nucleolus (*N*). Of the eleven univalent chromosomes derived from the spermatogonium, ten unite to form five bivalent pairs, while one (the eleventh) does not unite with any of the others but remains univalent.

In the first maturation division are found seven chromatin elements (Fig. 98, pole view); the smallest of these is bivalent, dumbbell-shaped, and is the chromatin nucleolus (*N. 2*); the six larger elements are chromosomes. Now a careful study of numerous monaster stages seen on lateral view shows that only five of these chromosomes are dumbbell-shaped, and so bivalent on analogy with what is known for the other *Hemiptera;* while one of them is never dumbbell-shaped, approximately half the volume of the others, and is univalent. Fig. 99 is a lateral view of the spindle of the first maturation division, showing three of the five dumbbell-shaped chromosomes and (most to the right) the univalent chromosome. In all cases where the chromosome plates of this stage can

be seen on lateral view, one chromosome is always found to be of about half the size of the others and not dumbbell-shaped; on pole views this chromosome can be distinguished by its lesser depth.

So in *Alydus eurinus* there is an uneven number of chromosomes in the spermatogonia, namely, eleven; the reduction in number is effected then in the synapsis by ten combining to form five bivalent ones, while one remains univalent and uncombined, because there is no mate with which it can unite.

In the monaster of the second maturation division there are either six or seven chromatin elements. In Fig. 100 of this stage are shown seven, of which the smallest is probably the chromatin nucleolus, five are halves of the originally bivalent chromosomes and one probably the half of the originally univalent chromosome.

In the spermatid we find either six (Fig. 102) or five (Fig. 101) chromatin elements of approximately equal volume. Now these elements are too large to be derivatives of the chromatin nucleolus of the spermatocyte of the first order (*N. 2*, Fig. 98), so that the five or six elements of the spermatids would not seem to represent portions of this chromatin nucleolus; very probably the latter is so small in the spermatids or generally so closely applied to the surface of one of the chromosomes that it escapes observation. If we then eliminate the possibility of any of the elements shown in the spermatids (Figs. 101, 102) representing chromatin nucleoli or their derivatives, then we must conclude that the five or six elements here are chromosomes. But why is their number sometimes five, in other cases six? Now we know that in all other *Hemiptera* in which attention has been given to this point that each spermatid receives one-quarter of each of the bivalent chromosomes present in the spermatocyte of the first order. Accordingly it would be probable by analogy that in *Alydus eurinus* the spermatid receives one-quarter of each of the original five bivalent chromosomes. Then in the case of Fig. 101 all five elements would be such derivatives; in Fig. 102, five of the six elements. The sixth element of Fig. 102 is then probably the original univalent chromosomes of the first maturation division, which in either the first or the second maturation division could not have been divided, but must have passed undivided into one of the daughter cells; this would explain why sometimes there are only five, sometimes six chromosomes in the spermatid, for, as I have explained, none of the elements of Figs. 101 and 102 can be regarded as chromatin nucleoli.

Of course the preceding is only an attempt at a right interpretation; I have not been able to follow the univalent chromosome with precision in regard to its behavior in the maturation divisions.

20. *Corizus lateralis* Say

Four testes of this species were studied.

I could not determine whether there are chromatin nucleoli in the rest stage of the

spermatogonia, and none of the cases of spermatogonic monasters in my preparations were sufficiently favorable to allow accurate counting of the chromatin elements.

In the growth period of the spermatocytes a comparatively small, bivalent chromatin nucleolus, which in the rest stage (*N. 2*, Fig. 103, Pl. III) has a peripheral position and rounded form and is not apposed to the true nucleolus (*N*). Besides this chromatin nucleolus one or two much smaller, rounded ones can sometimes be seen in the nuclei of the resting spermatocytes, and these stain like the large one with the double stain of Hermann.

In the monaster stage of the first maturation division are always found at least seven chromatin elements; when there are eight the eighth is a small granule (Fig. 105, the smaller of the bodies marked *N. 2*), and this small element, which frequently cannot be seen at this stage, probably represents one of the minute chromatin nucleoli of the growth period. Of the seven larger elements the smallest, centrally placed one is the bivalent chromatin nucleolus (*N. 2*, Fig. 104, and the larger of the elements marked *N. 2* in Fig. 105); this chromatin nucleolus often has its component halves separated (except for a joining linin band) before the period of metakinesis (Fig. 106). The remaining six elements are chromosomes, and of them four are of approximately equal volume, while one is always much larger and one always much smaller than these four (pole views Figs. 104, 105, lateral view Fig. 106). The five largest chromosomes are clearly dumbbell-shaped on lateral view, and accordingly by analogy with the corresponding elements of other *Hemiptera* may be considered bivalent, even though the number in the spermatogonia was not determined. But the smallest chromosome puzzled me at first with regard to its valence, for it is not more than half the volume of the other five, and sometimes it does not appear dumbbell-shaped, so that I considered the possibility of its being univalent; but a careful study of it in numerous cells of the first maturation division resulted in showing in a number of clear cases that it is transversely constricted even before it becomes arranged in the plane of the equator, so that there can hardly be a doubt as to its being bivalent. Fig. 106 shows such a case in an oblique lateral view of the spindle before the chromosomes have become arranged all in one plane, with a well-marked constriction of the smallest chromosome.

The first maturation division is a reduction division and always halves the six chromosomes and the bivalent chromatin nucleolus.

21. *Harmostes reflexulus* Stal.

Thirteen testes of this species were studied.

In the rest stage of the spermatogonia there are two rounded chromatin nucleoli (*N. 2*, Fig. 107, Pl. III), of which one or both may be apposed to the true nucleolus (*N*).

In the monaster stage of the spermatogonic divisions can always be counted thirteen chromatin segments on favorable pole views—*i. e.*, in such cases where these elements can be seen all in one plane, and where they are not too closely apposed to one another (Figs. 108–110). Two of these elements are always distinguishable from the others by their smaller size and rounded shape, and these are the chromatin nucleoli (*N. 2*); they may lie close together (Fig. 110), but more usually are more separated in position (Figs. 108, 109). The remaining eleven elements, which are of large size and elongate form, are chromosomes. There can be no doubt that this is the actual number of these chromosomes, for no exceptions to it were found, and in fourteen clear cases from four different testes the number eleven was obtained with great clearness; these chromosomes are larger than the spermatogonic chromosomes of any other Hemipteron examined. Sometimes one or more of the chromosomes may show a slight transverse constriction, but this is not a constant appearance.

In the synapsis the two chromatin nucleoli derived from the spermatogonium unite to form one bivalent one; in the rest stage (which is very complete) of the spermatocyte it is elongate (*N. 2*, Fig. 111), peripheral in position and not attached to the true nucleolus; the latter is larger (*N*, Fig. 111), frequently peripheral in position, and sometimes two true nucleoli are present.

During the synapsis stage ten of the eleven chromosomes join to form five bivalent chromosomes, while the eleventh remains univalent, as will become evident from the following description:

In the first maturation division are found either seven chromatin elements or eight chromatin elements; these two conditions may be described successively.

When there are seven elements (Fig. 112 pole view of the monaster stage, Fig. 113 lateral view) one may always be distinguished by its smaller size and central position, and by its history from the rest stage of the spermatocyte to the stage under discussion this is found to be the chromatin nucleolus (*N. 2*); this we have already learned to be bivalent, and in Fig. 113 its univalent components are seen to be separating. The six larger elements are chromosomes. Five of these, as Fig. 113 shows, are clearly dumbbell-shaped and bivalent. The sixth, however (*x*), never shows a dumbbell shape before the metakinesis, but is always distinguishable from the others by its oval form. From these appearances we must conclude that this sixth chromosome is univalent—represents the odd, eleventh, chromosome of the spermatogonic monaster stage, which had no mate with which to unite during the following synapsis stage. It was in this species that I first found spermatogonia with an uneven number of chromosomes, so that I first concluded they must be abnormal cases, for heretofore in all objects the spermatogonic (normal) number has been described as an even one; I immediately sectioned testes of other

individuals to determine this point, but, as has been already stated, in the four of the thirteen testes which contained spermatogonic divisions exactly eleven chromosomes were found to be always present. Obviously all of the eleven chromosomes cannot unite into pairs during the synapsis, one must remain unmated, and this must be necessarily that one of the first maturation division which does not appear bipartite.

Now in those cases where there are eight chromatin elements present in the spermatocytes the question becomes more complicated (Figs. 114–116). Here, as in the cases where there are seven elements, one is central in position and distinguishable from the others by its smaller volume, namely, the bivalent chromatin nucleolus (*N. 2*, Figs. 114–116, in the last figure its univalent components separated); the remaining seven elements are then chromosomes. As the lateral view, Fig. 116, of the spindle shows, four of these are bivalent (the ones not marked by lettering). One (x) is oval in form, showing no constriction or splitting, and so is probably comparable to the univalent chromosome of those cells which contain but seven chromatin elements (*i. e.*, to x in Fig. 113.) There then remain the two elements marked a in Fig. 116, and each of these I conclude must be a univalent chromosome, which in cases where there are only seven chromatin elements in the spindle would have combined with the other to form one bivalent chromosome; if this be so, then the transverse constriction of the left-hand chromosome marked a in Fig. 116 would not be the line of separation between two univalent chromosomes. Another reason for looking upon these two chromosomes as univalent, is because they are of approximately the same volume as the chromosome marked x, which we have shown to be univalent by comparison with the chromosome x of Fig. 113. But there is a still better reason for considering the elements a of Fig. 116 to be univalent chromosomes. A pole view of a corresponding stage with eight chromatin elements shows the seven chromosomes frequently equidistant from one another (as in Fig. 115). But often we find on pole view two of the seven chromosomes close together and connected by a band of linin (a, Fig. 114); the two together constitute a virtual bivalent chromosome, which, however, differs from the other bivalent ones in having its long axis parallel to the plane of the equator of the spindle. Let the band of linin which connects these chromosomes a become stretched out, and as a result we would have a bivalent chromosome lying parallel to the plane of the equator, and with its univalent halves widely separated—*i. e.*, the condition that maintains for the chromosomes a of Fig. 116.

To summarize, we find two conditions in the spermatocytes: (1) there are seven chromatin elements, namely, one bivalent chromatin nucleolus, five bivalent chromosomes, and one univalent chromosome; and (2) eight chromatin elements, namely, one bivalent chromatin nucleolus, four bivalent chromosomes, one univalent chromosome (corresponding to that of condition 1), and two other univalent chromosomes (which

together would correspond to the fifth bivalent chromosome of condition 1). To determine which of these conditions is the more usual, I counted the number of chromatin elements seen on pole views of the monaster stage of the first maturation division. These counts were made on spermatocytes from five different testes, and may be condensed into the following table:

PREPARATION NO.	EIGHT ELEMENTS.	SEVEN ELEMENTS.
86	4	33
238	6	12
408	2	1
410	1	9
356	0	23
Total =	13	78

Thus those spermatocytes with seven chromatin elements would seem to be the more frequent condition. In both cases there is one univalent chromosome, which represents the odd chromosome of the spermatogonia; but why in cells of the second condition two chromosomes should remain separated instead of combining to form a bivalent one, as they do in the first condition, I cannot explain, unless perhaps the presence of the odd univalent chromosome may in some way disturb the union into pairs of the ten other chromosomes during the synapsis.

In those cases where there are seven chromatin elements in the equator of the first maturation spindle, the metakinesis results in the division of all the elements; this is a reduction (transverse) division of the bivalent chromatin nucleolus and of the five bivalent chromosomes, but in what plane the univalent chromosome divides could not be determined. Only one case was seen where the univalent chromosome was left undivided in the equator after the daughter elements of the six other elements had reached opposite poles of the spindle. Thus it would seem that in this division, in the cases where there are seven elements present, all the elements become divided; how it is in the cases where there are eight elements could not be determined. In the spermatid are found either six chromosomes (Fig. 117) and one chromatin nucleolus (*N. 2*), or five chromosomes and one chromatin nucleolus. This would show that the chromatin nucleolus and five chromosomes (the derivatives of the original five bivalent ones) divide in the second maturation division, but that the sixth chromosome, the derivative of the originally univalent one, does not divide but passes undivided into one of the two spermatids. Thus the valence of the seven elements in these generations would be: *first spermatocyte*, one bivalent chromatin nucleolus, five bivalent chromosomes, one univalent chromosome;

second spermatocyte, one univalent chromatin nucleolus, five univalent chromosomes, one semivalent chromosome; *spermatid*, one semivalent chromatin nucleolus and either five or six semivalent chromosomes.

22. *Protenor belfragei* Hagl.

Five testes of this exceedingly interesting species were studied from individuals that had just completed their last ekdysis.

In the rest stage of the spermatogonia (Pl. III, Fig. 118) are two rounded chromatin nucleoli which are usually attached to the surface of a much larger true nucleolus (*N*).

Pole views of the monaster stage of the spermatogonic mitosis show with great distinctness exactly thirteen chromatin elements (Figs. 119-123). This number was found in thirteen cells of one testis, in about sixteen cells of a second, in six cells of a third, and in two cells of a fourth—these being all the favorable cases found, and all these testes had been fixed with Flemming's fluid (the stronger mixture). The fifth testis sectioned had been fixed in picro-acetic acid, and in it the number of chromosomes could not be counted because of the swelling action which this reagent exerts upon the chromatin. These chromosomes are unusually large and on suitable preparations can be counted with exactness. In only two of the cells in which they were counted was there observed a fourteenth element; this was a minute granule (*t*, Fig. 121), which, on account of its being present so rarely in these monaster stages and on account of there being no element to represent it in the later history of the spermatogenesis, need not be taken into account; it seems to be very inconstant, and might possibly represent either a portion of chromatin which had become separated from one of the chromosomes, or a chromatin nucleolus transmitted from some distant parent and now nearly reaching disappearance.

Which two of the elements in the spermatogonic monaster represent the chromatin nucleoli of the previous rest stage I am unable to determine, but that two of them do represent these bodies there can be no doubt from what has been determined for the succeeding stages; judging by analogy with the case in all other *Coreidæ* examined, they would probably be the two smallest elements. Now Figs. 119–123 show what is to be seen very distinctly in all cases, namely, that there are three chromatin elements much larger than the ten remaining. One of these three, that designated *x* in Figs. 119–123, imposes by its relatively very large volume; this has in most cases the form shown in Figs. 120 and 121, but in a few cases it was noticeably elongated, as in Figs. 122 and 123. The last figure shows it to have a transverse constriction around the middle; and this case, together with the fact of its great volume, would show it to be equal potentially to at last two chromosomes; for purposes of description we shall call this the "chromosome *x*." The two other chromosomes, which can always be recognized by their relatively

large volume, are those designated by the letter *k* in Figs. 119–123; these two are of approximately equal volume, and each has about half the volume of the chromosome *x*.

There are accordingly present in the spermatogonic monaster thirteen chromatin elements, of which two (probably the smallest) represent the chromatin nucleoli; of the eleven chromosomes, three are much larger than the others, namely, the one marked *x* and the two marked *k* in the Figs. 119–123. In the metakinesis all these elements are halved longitudinally.

In the following synapsis stage we find a small chromatin nucleolus composed of two parts, which in every way is comparable to the bivalent chromatin nucleolus of the growth period of other *Coreidæ;* this is marked *N. 2* in Figs. 124, 129, 130. This chromatin nucleolus is peripheral in position, and only occasionally has a true nucleolus apposed to it (Fig. 130). Generally its two univalent halves are not closely apposed but more or less separated, often widely separated (*N. 2*, Fig. 131), but the two always come close together to form a dumbbell-shaped, bivalent body before the monaster stage of the first maturation division. Certainly its two components must represent the two univalent chromatin nucleoli of the rest stage of the spermatogonia (*N. 2*, Fig. 118).

During the synapsis stage also ten out of the eleven chromosomes derived from the spermatogonium combine to form five bivalent chromosomes, as will be shown in treating of the maturation divisions. The odd one of the eleven chromosomes does not combine with any other during the synapsis stage, and this is the largest of the chromosomes of the spermatogonium, namely, the chromosome *x*. This element has a remarkable history in the growth period. Through the whole growth period it acts like a chromatin nucleolus in preserving a compact form and in continuing to take the saffranine stain with the use of the double stain of Hermann, while the other chromosomes take the violet stain. It will be remembered that this chromosome *x* becomes distinguishable first in the spermatogonic mitoses (Figs. 119–123), while in the preceding spermatogonic rest stage it cannot be distinguished, for then it takes the violet stain like the other chromosomes and takes part in the formation of the nuclear riticulum just as they do; accordingly it can be concluded that it commences to behave differently from the other chromosomes at the beginning of the growth period of the spermatocyte. In the early synapsis (Fig. 124) it has the same general shape as in the spermatogonic monaster stage (compare the element marked *x* in Fig. 124 with the corresponding one in Figs. 120, 121), but it has greatly increased in volume, as a comparison of these figures show, since it will be recalled that the chromosome *x* of the spermatocytes is a half of the chromosome *x* of the spermatogonia. Later in the growth period the chromosome *x* elongates into the form of a bent rod (Figs. 125–130), which usually lies close to the nuclear membrane (in this point also resembling a chromatin nucleolus); throughout the growth period it keeps its com-

pact structure and smooth outline. When it is beginning to elongate a faintly-marked clear line can be seen in its long axis (Figs. 125, 129), and this is evidently a longitudinal split, comparable to that of the bivalent chromosomes; this split cannot be seen in the telophase nor at any period of the maturation divisions. About coincidently appears a transverse split; this may be a simple annular constriction, or a clear connecting bridge of linin (as in Fig. 128). This transverse constriction, pointing to a bipartite nature, would show that the chromosome *x* is bivalent; but it must have been already bivalent in the spermatogonia (where also a transverse constriction can sometimes be seen, Fig. 123), for it does not unite with any other chromosome in the spermatocytes. I can find no other explanation for its occasional bipartite appearance during the synapsis.

In the later period of the synapsis stage, in the telophase, and in the early prophases of the first maturation division the chromosome *x* undergoes considerable changes in form. The slightly bent rod (Figs. 125, 129) of the early synapsis bends at its middle point, where the transverse constriction was apparent, into the form of a U or V (Figs. 126, 127, 130), or even the form of an S (Fig. 127*b*). The end result of these bendings seems always to be a horseshoe-shape (Fig. 130) or a nearly closed ring (Fig. 127*c*). From the early synapsis stage until the beginning of the prophases of the first maturation mitosis a true nucleolus of varying form is attached to the surface of the chromosome *x* (*N*, Figs. 124, 125, 127–130); occasionally this true nucleolus may be separated into two or three parts, all of them attached to the chromosome. In the prophases of the first maturation division the nucleolus becomes detached from the chromosome, rapidly decreases in size, and becomes lost before the nuclear membrane disappears.

In the early prophases of the first maturation division (Figs. 131, 132) are found the following elements: (1) five bivalent chromosomes, of which all five are shown in Fig. 132, only four in Fig. 131 (all these seen on lateral view); all these show at this stage a well-marked longitudinal split (often of circular or oval outline) and a transverse split (which marks the point of union of two univalent chromosomes); the mode of formation of these elements is very similar to that described by Paulmier (1899) for *Anasa*. (2) The bivalent chromatin nucleolus, the two parts of which may be in close contact (*N. 2*, Fig. 132) or may still be widely separated (*N. 2*, Fig. 131). And (3) the large chromosome *x*, the largest of all the elements, which now has decreased somewhat in volume owing to the greater condensation of its substance; seen from the side, it gives the appearance of a thick horseshoe or a nearly closed ring (*x*, Fig. 131). Of the five bivalent chromosomes, one is always much larger than the others (*K. 2*, Figs. 131, 132), and this was evidently formed by the union of the two large chromosomes *K* of the spermatogonic mitoses (Figs. 119–123).

In the later prophases (Figs. 133, 134) the five bivalent chromosomes condense into the form of dumbbells or sometimes of rings, the large chromosome *K. 2* (Fig. 133) passing through these stages more slowly than the others, so that it often retains loose texture and roughened outlines after the four others have become compact with smooth outlines. The bivalent chromatin nucleolus now has its univalent components generally in rather close apposition (*N. 2*, Figs. 133, 134). The chromosome *x* is very compact in structure, and when seen from the side has squarish form (*x*, Fig. 133), an indentation at one end of which marks the point of apposition of the ends of the primitive horseshoe form—which latter in some cases (Fig. 134) may still be seen at this late stage. Usually the chromosome *x* is longer than broad, and the clear line sometimes found in its long axis does not then represent the primitive longitudinal split, of which there seems no trace at this stage, but the space separating the two arms of the horseshoe.

In the monaster stage of the first maturation mitosis (Figs. 135–137) there are accordingly seven elements (in the cell from which Fig. 136 was drawn, one of the bivalent chromosomes lay out of the plane of the section). These are the bivalent chromatin nucleolus (*N. 2*), the smallest of all; the chromosome *x* (*x*), the largest of all; and five bivalent chromosomes, of which one is almost always recognizable by its greater volume (*K. 2*), and this is the bivalent chromosome formed by the synapsis of the two larger chromosomes *K* of the spermatogonia. The five bivalent chromosomes and the chromatin nucleolus become divided transversely in the metakinesis (reduction division). The chromosome *x* (for successive stages in its division, Figs. 136, 138), which has its long axis coinciding with the plane of the equator, becomes divided into two along its median axis. This would appear at first sight to be a longitudinal (equational) division; but it is not, for we have learned that this peculiar chromosome had first the form of a straight rod, which then bent at its middle point into a U or V, then the arms of the U or V laid themselves parallel to and close together, so that a division along the median axis results now in the separation of these arms, and is accordingly a reduction division.

A view of the second spermatocyte, before its chromatin elements have definitely arranged themselves in the plane of the equator of the spindle, shows also seven elements (Fig. 139): one univalent chromatin nucleolus (*N. 2*); one chromosome larger than the others, a half of the original chromosome *x* (*x* ½); and five univalent chromosomes, one (*K*) larger than the others and directly comparable to one of the large chromosomes *K* of the spermatogonia. In the metakinesis following (Fig. 140) the five univalent chromosomes are divided equationally, and the univalent chromatin nucleolus (*N. 2*) is also divided (but in what plane was not determined). The chromosome *x* ½, however, never becomes divided in this mitosis, but passes undivided into one of the daughter cells (Fig.

140); and in the dyaster stage of the second maturation division (Fig. 141) we see in each daughter cell (spermatid) the chromosomes densely apposed, forming together a rounded, irregular mass, and in only one of the two daughter cells the chromosome $x\,\frac{1}{2}$.

The reduction of the number of chromatin elements in *Protenor belfragei* is accordingly as follows: *Spermatogonium*, two univalent chromatin nucleoli, ten univalent chromosomes, one chromosome *x*; *first spermatocyte*, one bivalent chromatin nucleolus, five bivalent chromosomes, one chromosome *x*; *second spermatocyte*, one univalent chromatin nucleolus, five univalent chromosomes, one-half chromosome *x*; *spermatid*, one semivalent chromatin nucleolus, five semivalent chromosomes, and either present or absent one-half chromosome *x*. This chromosome *x* is the odd one of the spermatogonia; it does not unite with any other one in the synapsis stage of the spermatocyte, yet since it sometimes appears bipartite in the synapsis and undergoes a transverse division in the first maturation mitosis, it may perhaps be looked upon as bivalent in both spermatogonium and spermatocyte. If this is a correct conclusion, then the uneven number of chromosomes in the spermatogonia would be the result of two univalent ones remaining there united instead of separating—this compound, bivalent one being the chromosome *x*. This chromosome, as we have seen, behaves in the rest stage of the spermatogonia like the other chromosomes, but in the growth period of the spermatocytes it acts in many ways like a chromatin nucleolus.

LYGÆIDÆ.

23. *Cymus augustatus* Stal.

Six testes of this species were studied.

There was no material at my service fixed with Flemming's or Hermann's fluids, so not being able to use the triple stain of Hermann I was unable to determine the relations of the chromatin nucleoli in the rest stage of the spermatogonia. The preparations also showed no favorable cells for counting the chromosomes in this generation.

In the synapsis stage there is a rather small, dumbbell-shaped, and so probably bivalent, chromatin nucleolus, which becomes spherical in the following (complete) rest stage of the spermatocyte.

There were no pole views of the chromosomal plate of the first maturation division, but two pole views of the succeeding dyaster are here given (Pl. IV, Fig. 143, showing the chromosomes before taking their definite position in the spindle, while in Fig. 144 they occupy this position and are seen from their ends); here can be counted twelve chromosomes and one smaller body (*N. 2*, probably the chromatin nucleolus, very small in Fig. 144). On lateral views of the first maturation monaster (Fig. 142, which, however, shows only nine of the elements), all the chromosomes usually appear dumbbell-

shaped, and so would be bivalent. Sometimes one of them appears rounded or oval instead of dumbbell-shaped; this may be a bivalent one seen obliquely, or it might possibly be a univalent one; the lack of knowledge of the spermatogonic number does not permit us to decide which.

24. *Ichnodemus falicus* Say

Five testes of this species were studied.

Chromatin nucleoli were not determined in the rest stage of the spermatogonia. But they are very probably present there because two small rounded ones can be seen in the late spermatogonic prophases; whether more than two I could not determine. All the testes examined had been fixed with picro-acetic acid, causing such a swelling and consequent juxtaposition of the chromosomes that in only one case were they sufficiently separated to be counted (Pl. IV, Fig. 145), and here fourteen chromatin elements were present. Since in the first maturation spindle there are always seven bivalent chromosomes, I should think that the fourteen elements of Fig. 145 are univalent chromosomes, and that in this monaster the chromatin nucleoli are hidden.

In the monaster stage of the first maturation division are seen on pole views (Figs. 147, 148) always seven larger elements, which on lateral view are found to be all dumbbell-shaped, and so are probably bivalent. All these seven elements are presumably chromosomes corresponding to the fourteen found in the spermatogonia (Fig. 145). Besides these are to be seen at this stage, and also in the preceding prophases (Fig. 146), two or three smaller elements, which are presumably chromatin nucleoli. Generally three of these are found (*N. 2*, Figs. 146, 147), and generally the case is as in Fig. 146, two larger and one smaller. The two larger being generally of approximately equal volume (Figs. 146, 148), it is quite probable that taken together they may represent one bivalent chromatin nucleolus with separated components. The smaller one sometimes appears transversely constricted, as in Fig. 146, so this one may also be bivalent; if this is the case, then there should be four univalent ones in the spermatogonia. But the number of them could not be determined in the spermatogonia, and in the growth period of the spermatocytes the stain was not favorable for showing their relations.

25. *Peliopelta abbreviata* Uhl.

Five testes of this species were studied.

In a pole view of the spermatogonic monaster (Pl. IV, Fig. 149, the only clear case observed) are found sixteen chromatin segments, ten of which are larger and more elongate than the others, while six are rounded and smaller. The two smallest (*N. 2*) are probably chromatin nucleoli, by analogy with other species of the *Lygæidæ*.

In the growth period of the spermatocytes there is one clearly bivalent chromatin nucleolus, which is frequently apposed to the larger true nucleolus.

In the monaster stage of the first maturation division (Fig. 150, pole view) there are eight elements, the smallest of which is the chromatin nucleolus (*N. 2*); on lateral view all these elements appear dumbbell-shaped and hence are bivalent (Fig. 151). Of the seven chromosomes of this stage, two are very small and five much larger, the two small ones in Fig. 151 being designated as *a. 2* and *b. 2*, while in the figure only three of the large ones are shown. Apparently the two small chromosomes of the spermatocyte correspond to the four small chromosomes of the spermatogonium; thus the bivalent chromosomes *a. 2* and *b. 2* of Fig. 151 would correspond respectively to the univalent chromosomes *a* and *b* of Fig. 149, and the five large bivalent chromosomes of the spermatocyte to the ten large univalent ones of the spermatogonium. It is very evident that in the synapsis stage one of the small univalent chromosomes derived from the spermatogonium never unites with one of the large, for the two univalent components of each small bivalent chromosome of the spermatocyte have approximately the same volume. This speaks, of course, very strongly for the maintenance of the individuality of the chromosomes during these generations.

26. *Œdancala dorsalis* Say

Four testes of this species were studied.

In the rest stage of the spermatogonium are present two chromatin nucleoli of rounded form (*N. 2*, Fig. 152, Pl. IV); these are sometimes attached to one another, sometimes to the true nucleolus (*N*).

In the spermatogonic monaster there are thirteen chromatin elements present, exactly this number being found in all of nine clear cases. Two of these, which are rounded and much smaller than the others, are the chromatin nucleoli (*N. 2*, Figs. 153, 154); the remaining eleven elements are relatively large, elongated chromosomes. All these elements are halved in the metakinesis.

In the synapsis stage the two chromatin nucleoli combine to form one bivalent one, and even up to the rest stage of the spermatocyte (Fig. 155) it remains dumbbell-shaped, with a bridge of linin connecting its univalent components; it is attached to the surface of the true nucleolus (*N*, Fig. 155), and the "double nucleolus" so formed usually lies close to the nuclear membrane.

In the first maturation division there are seven chromatin elements (Fig. 156, pole view of monaster stage), of which the smallest, usually centrally placed one is the bivalent chromatin nucleolus (*N. 2*). Of the six chromosomes, five, when seen on lateral view, are dumbbell-shaped, and so bivalent; but the sixth is oval in outline without any

transverse constriction, about the size of a univalent component of one of the bivalent chromosomes. This is the chromosome marked *x* in Fig. 157; in this figure is shown also the chromatin nucleolus (*N. 2*), but only two of the five bivalent chromosomes. This sixth small chromosome is univalent and unipartite, and evidently is the odd, eleventh, chromosome of the spermatogonium, which had no fellow to combine with during the synapsis. It is always recognizable on lateral views (Fig. 157) by its peculiar volume and form, and even on pole views of the chromosomal plane is recognizable by its lesser depth (Fig. 156, *x*).

The first maturation division halves all seven elements (Fig. 158, anaphase), being a transverse (reducing) division of the five bivalent chromosomes and of the chromatin nucleolus, but in what plane the univalent chromosome (*x*) divides could not be determined on account of its nearly spherical form. Apparently also in the second maturation division all the six chromosomes become divided, since in the spermatid six chromatin elements can frequently be counted; but I am not certain that the sixth chromosome does become divided in this mitosis.

The reduction in the number of chromosomes for this species is accordingly: *Spermatogonium*, two univalent chromatin nucleoli, eleven univalent chromosomes; *first spermatocyte*, one bivalent chromatin nucleolus, five bivalent chromosomes, one univalent chromosome; *second spermatocyte*, one univalent chromatin nucleolus, five univalent chromosomes, one semivalent chromosome.

27. *Oncopeltus fasciatus* Dall.

Eight testes of this species were studied.

The rest stage of the spermatogonium (Pl. IV, Fig. 159) shows usually one comparatively large, elongate chromatin nucleolus (*N. 2*), which is generally peripheral in position; this apparently represents two joined end to end, for sometimes two separate ones can be seen.

In the spermatogonic monaster there are sixteen chromatin elements (Fig. 160). Fourteen are chromosomes and two are chromatin nucleoli, as the relations in the spermatocyte mitoses will demonstrate. But it is difficult to determine which two are the chromatin nucleoli, all sixteen elements being of approximately equal size, though, judging by analogy with the other species of the family, they are probably the smallest two (*N. 2*, Fig. 160).

In the synapsis the fourteen chromosomes unite to form seven bivalent ones. But there is never any very close union of the two chromatin nucleoli, and in the rest stage of the spermatocytes the following conditions are found: (1) the chromatin nucleoli apposed to one another and to the true nucleolus (Fig. 161); (2) apposed to one

another, but separated from the nucleolus (Fig. 162); (3) the chromatin nucleoli separate from one another, and only one in contact with the nucleolus (Figs. 163, 165); (4) the chromatin nucleoli separate from one another and from the nucleolus; (5) the chromatin nucleoli separate from one another, but both attached to the nucleolus (Fig. 164). These conditions do not appear to be stages in position, but rather individual variations. Whenever the two chromatin nucleoli are mutually apposed, it is never an intimate apposition—*i. e.*, they never fuse to form one large rounded one such as is the general rule in the *Pentatomidæ*. Through the rest stage of the spermatocytes each chromatin nucleolus remains elongate (they appear round only when seen from the end). Sometimes each shows a trace of a transverse constriction, and in one case (Fig. 165) one of them was separated into two parts.

Through the prophases of the first maturation mitosis the chromatin nucleoli remain separate from one another, and each is elongate in form (Fig. 166, *N. 2*, showing also all seven bivalent chromosomes on lateral view).

Pole views of the monaster stage of the first maturation division show in most cases nine chromatin elements (Fig. 167); the seven larger ones are chromosomes, all bivalent and on lateral view dumbbell-shaped (Fig. 166); the two smaller, centrally placed ones are the two chromatin nucleoli (*N. 2*, Fig. 167). In one case, ten elements were seen on pole view (Fig. 168); this is very unusual, but it may probably be explained by the assumption that there are here two chromatin nucleoli, six bivalent chromosomes, and two univalent chromosomes formed by the precocious separation of the parts of a bivalent chromosome. A lateral view of the spindle is given (Fig. 169), showing the two chromatin nucleoli, but only two of the seven bivalent chromosomes.

In the metaphase of this mitosis all seven chromosomes become transversely divided (reduction division), and each of the chromatin nucleoli becomes also divided in a plane perpendicular to its long axis (compare Figs. 169 and 170, in each of which only two of the seven chromosomes are shown). A pole view of one cell of the dyaster stage following (Fig. 171) shows the two daughter chromatin nucleoli (*N. 2*) and the seven daughter (univalent) chromosomes (the apparent transverse constrictions on them representing the reappearance of the original longitudinal split; compare the left-hand chromosome of Fig. 170).

The behavior of the chromatin nucleoli is thus different from that of the other *Hemiptera* examined in the following regards: (1) their large size in the spermatogonic monaster (Fig. 160), so that they can hardly be distinguished in volume from the chromosomes; (2) the phenomenon that they remain more or less separate from one another during the growth period of the spermatocytes (Figs. 161–165) and prophases of the first maturation division (Fig. 166); (3) the fact that one or both may appear

bipartite in the growth period (Fig. 165); and (4) the fact that they remain separate from one another in the first maturation division, and that each divides transversely (Figs. 167, 169, 170, *N. 2*). The last mentioned point deserves particular consideration, for a transverse division of a chromatin element in the *Hemiptera* always means a reduction division—*i. e.*, a separation of two whole univalent components of one already bivalent element. From these facts we are led to the conclusion that here the chromatin nucleoli are virtually bivalent in the spermatogonia, and that since the spermatogonic division gives a longitudinal half of each of them to the spermatocytes, that each is already bivalent in the spermatocytes—a bivalence then produced before the synapsis stage of the growth period. This conclusion would explain all their peculiarities listed above. In the spermatogonium accordingly there would be virtually four chromatin nucleoli, twice the number found in the other species of the *Lygæidæ* (with possibly the exception of the not fully explained *Ichnodemus falicus*).

CAPSIDÆ.

28. *Leptopterna dolabrata* Linn.

Three testes of this species were studied.

There were no spermatogonia on any preparations (taken from adults in the last instar before copulation).

In the rest stage of the growth period of the spermatocytes are found the following relations for the chromatin nucleoli: There are two chromatin nucleoli, which (1) are attached to one another but separate from the true nucleolus (Plate IV, Fig. 172); (2) they are attached together and to the true nucleolus (Fig. 173); (3) they are separated from one another but both attached to the true nucleolus (Fig. 175), often at opposite poles of the latter (Fig. 174). In almost all cases they are attached to the true nucleolus, so that Fig. 172 represents an unusual case. Each chromatin nucleolus is probably a univalent one, for it never shows a bipartite appearance and is usually rounded, so that in Figs. 172 and 173 the two together would constitute one bivalent chromatin one; but there cannot be certainty on this point until the number in the spermatogonia is determined.

Pole views of the monaster stage of the first maturation division (Fig. 176) show seventeen chromatin elements, one of which, centrally placed, is always much larger than the others. On lateral view all appear dumbbell-shaped and so are probably bivalent. Probably one of these elements represents the bivalent chromatin nucleolus described for the growth period, then the sixteen remaining would be chromosomes.

29. *Calocoris rapidus* Say

Three testes of this species were studied.

The number of chromatin nucleoli in the rest stage of the spermatogonia was not determined.

In the most favorable pole view of a spermatogonic monaster were counted about thirty chromatin elements (Plate IV, Fig. 177), but these elements were densely grouped so that I could not be positive as to the exact number. Since there are in the spermatocytes fourteen bivalent chromosomes, two bivalent chromatin nucleoli and one that is probably univalent, there would be probably in the spermatogonia twenty-eight univalent chromosomes and five univalent chromatin nucleoli, a total of thirty-three elements.

In the telophase and rest stages of the spermatocytes there is a large true nucleolus, which is remarkable in being flattened against the nuclear membrane (*N*, Figs. 178, 179); it appears sickle-shaped on cross section, and has irregularly lobular outlines on surface view. In these stages there are five small chromatin nucleoli (*N. 2*, Fig. 178); one of these is larger than the others and always spherical in form (the larger one of Figs. 178 and 179), and since it never appears bipartite is presumably univalent; it is frequently attached to the true nucleolus. The four other chromatin nucleoli are arranged in two pairs, the two components of a pair being connected by a band of linin (Figs. 178, 180, only one of the pairs shown in Fig. 179). Each one of these four is very small and spherical, and accordingly probably univalent, and each pair would then be bivalent. Thus there would appear to be in the spermatocytes one larger univalent chromatin nucleolus and two bivalent ones, in each of the latter the univalent components being not closely apposed.

Pole views of the monaster stage of the first maturation division show always sixteen chromatin elements (Figs. 185, 186). Three of these are always distinguishable by their much smaller size (*N. 2*, Figs. 185, 186). These three probably represent the three chromatin nucleoli of the preceding growth period; two of them appear dumbbell-shaped on lateral view (Fig. 181, and one of the two is shown in Fig. 184), obviously representing the two bivalent ones of the growth period; while the third one always appears rounded and never dumbbell-shaped (Fig. 181, the lowest of the elements designated *N. 2*), and on lateral view of the spindle lies nearer one pole of the spindle than the other (*N. ,2* Fig. 183), this one obviously representing the univalent chromatin nucleolus of the growth period. Figs. 181–184 represent oblique lateral views of the spindles, so that in each case only one spindle pole is shown, such oblique views giving the best views of the chromatin elements. The thirteen remaining larger elements of the first spermatocytes are chromosomes, and lateral views show that twelve of these are dumbbell-shaped and hence probably bivalent; but the thirteenth is quadrivalent, composed of two bivalent (dumbbell-

shaped) placed side by side with their long axes parallel. This quadrivalent chromosome shows its nature plainly on lateral view (*t*, Figs. 182, 183); on pole view it may always be told by its greater volume (*t*, Figs. 185, 186), sometimes even on pole view it appears slightly constricted (Fig. 186, *t*), the constriction then denoting the plane of apposition of the two bivalent chromosomes of which it is composed; it is placed in the spindle so that the tranverse constriction of each of its component chromosomes lies in the plane of the equator (Figs. 182, 183).

There are accordingly in the first spermatocyte two bivalent chromatin nucleoli, one univalent chromatin nucleolus, twelve bivalent chromosomes, and one quadrivalent chromosome, in all sixteen chromatin elements.

In the spindle of the second spermatocyte are found either fifteen chromatin elements (Fig 188) or sixteen (Fig. 187). This disparity in number is produced by the univalent chromatin nucleolus not dividing in the first maturation mitosis but passing undivided into one of the two daughter cells (second spermatocytes), for it will be remembered that in the monaster stage of the first mitosis it always lies a little outside of the plane of the equator, nearer one pole of the spindle than the other (Fig. 183, *N. 2*). The rest of the chromatin elements of the second spermatocyte are univalent halves of those in the first spermatocyte (the first maturation division is a reduction division), namely, halves of the two bivalent chromatin nucleoli, of the twelve bivalent chromosomes, and of the one quadrivalent chromosome. The latter element can be recognized in the second spermatocytes by its greater size (*t*, Figs. 187, 188), and it here consists of two univalent chromosomes placed in apposition; in the spindle of the first maturation mitosis (Figs. 182, 183) it was so placed that each of its bivalent chromosomes underwent a transverse (reduction) division, just as was the case with the other bivalent chromosomes.

30. *Pœcilocapsus lineatus* Fabr.

Six testes of this species were studied.

There were no spermatogonic mitoses on my preparations, and I could not determine the relations of the chromatin nucleoli in the rest stage of the spermatogonia.

In the rest stage of the spermatocytes are found two chromatin nucleoli (*N. 2*, Fig. 189, Pl. IV); in one testis two additional, very minute chromatin nucleoli seemed to be present, but I could not find them on the other preparations. One of the chromatin nucleoli is very large and clearly bilobed (Fig. 189) so that it would seem to be bivalent; the other is considerably smaller and apparently always rounded, so that it may be univalent. These two chromatin nucleoli are sometimes, but not usually, in mutual contact.

Pole views of the monaster stage of the first maturation mitosis show always eighteen chromatin elements (Fig. 190). One of these is much smaller and one much larger than

the others. Probably two of the eighteen elements correspond to the two chromatin nucleoli of the growth period, but I cannot determine which two they are; if this is so, then there would be here sixteen chromosomes (all apparently bivalent judging from their dumbbell-shape on lateral view), and one bivalent and one univalent chromatin nucleolus. But there can be no surety in regard to these valences without a knowledge of the numbers in the spermatogonia.

31. *Pœcilocapsus goniphorus* Say

Four testes of this species were studied.

There were no spermatogonic mitoses on my preparations (all from adult individuals).

In the rest stage of the spermatocytes there are present four bipartite chromatin nucleoli (*N. 2*, Figs. 192–195, Pl. V), in one single case there were five (Fig. 191). The largest of the four is composed generally of two rods placed side by side (this is shown in lateral view in Figs. 191, 194, in end view in Figs. 192, 193, 195); the lateral view of this one (the lower of the large ones of Fig. 191) sometimes shows that each of its component rods may be transversely constricted, which might imply that each of the rods is bivalent and hence that the whole is quadrivalent. In each of the three small bipartite chromatin nucleoli the univalent components may be closely apposed to one another (Figs. 191, 192), or may be more or less widely separated (Figs. 193–195). Of the four chromatin nucleoli the largest and the smallest are generally attached to opposite poles of the true nucleolus (*N. 2*, Figs. 191–194), though the relative positions vary considerably as shown by the figures; and it is the two which are generally not so attached which have their component parts most widely separated.

Thus there are at least four, possibly five, bivalent chromatin nucleoli in the spermatocytes.

Pole views of the monaster stage of the first maturation mitosis show either seventeen chromatin elements of approximately equal volume (Fig. 197), and this was the rule in two of the testes examined; while in a third testis in the majority of cases there was present a smaller element in addition to the seventeen larger ones (*t*, Fig. 196); possibly this small element may always be present, but frequently escape observation by being closely apposed to one of the larger elements. All these elements appear dumbbell-shaped on lateral view (Fig. 198), and so are probably bivalent.

How may of these eighteen elements are chromosomes and how many are chromatin nucleoli I cannot determine, since the number in the spermatogonia was not ascertained. Possibly the small element (*t* of Fig. 196) may represent the largest chromatin nucleolus of the preceding growth period, and the seventeen remaining be chromosomes; or if all four chromatin nucleoli are represented in the first maturation division, then there would remain fourteen chromosomes.

PHYMATIDÆ.

32. *Phymata* sp. (*P. wolffii* Stal.?).

Nine testes of this species were studied.

In the rest stage of the spermatogonium there are two chromatin nucleoli (*N. 2*, Fig. 199, Pl. V), usually unequal in size; frequently one or both of them is in contact with the true nucleolus (*N*).

In the spermatogonic monaster are seen on pole view (Fig. 200) thirty chromatin elements; two of these certainly represent the chromatin nucleoli, but they offer no peculiarities by which they can be distinguished from the twenty-eight small chromosomes.

In the synapsis stage the twenty-eight chromosomes unite to form fourteen bivalent ones, and the two chromatin nucleoli to form one bivalent one. The latter is in the telophase and rest stage of the spermatocyte (Fig. 201) clearly transversely constricted, showing its bipartite nature, and is always apposed to the surface of the larger true nucleolus (Fig. 201, *N.*).

Pole views of the monaster stage of the first maturation division (Fig. 202) always show exactly fifteen chromatin elements, namely, fourteen chromosomes and one chromatin nucleolus. All these elements are found to be dumbbell-shaped on lateral view (Fig. 203, showing eight of them), so that all are bivalent. The chromatin nucleolus cannot be distinguished in size from the chromosomes.

NABIDÆ.

33. *Coriscus ferus* Linn.

Three testes of this species were studied.

The relations of the chromatin nucleoli were not determined in the small nuclei of the spermatogonia, and the spermatogonic mitoses were not favorable for counting the small, rounded chromosomes.

In the growth period of the spermatocytes there is usually one large bivalent chromatin nucleolus, with its component parts in close apposition (*N. 2*, Fig. 205, Pl. V), attached to the true nucleolus (*N*). Sometimes its component parts (which are of equal volume) are separated from one another, and then both may be attached to the same true nucleolus (Fig. 204), or they may be apposed to separate nucleoli, or only one of them may be apposed to a nucleolus (of which there are generally two, sometimes three). Besides the large, bivalent chromatin nucleolus can be seen in most nuclei a much smaller chromatin nucleolus (Fig. 205) which stains like the larger one; it is generally close to the nuclear membrane, but is occasionally apposed to a true nucleolus.

In the first maturation division there are ten chromatin elements (Fig. 206, in which

five are seen on lateral view and five on pole view, all these elements not having taken their definite position in the equator of the spindle). All are bivalent, as is proved by their bipartite appearance on lateral view. One of them is smaller than the others, and may represent the large (bivalent) chromatin nucleolus of the growth period (*N. 2*, Fig. 206), while the nine remaining elements are probably chromosomes; if this interpretation be correct then the small (univalent?) chromatin nucleolus found in the growth period would not be represented in the first maturation division.

REDUVIIDÆ.

34. *Acholla multispinosa* De G.

Eight testes of this species were studied.

The relations of the minute chromatin nucleoli could not be determined in the rest stage of the spermatogonia.

In the most favorable pole view of a spermatogonic monaster (Pl. V, Fig. 207) could be counted thirty-one chromatin elements. The twenty-four larger elements seen here are univalent chromosomes, the seven smallest are chromatin nucleoli (some of them very minute). Of the latter there are six arranged in three pairs and one that is isolated. Now we shall find that in the spermatocytes there are four bivalent chromatin nucleoli (Figs. 208–211), so that in the spermatogonia there should be eight; and accordingly though only seven are to be seen in Fig. 207, we are justified in concluding that an eighth must be present there but hidden from view by one of the chromosomes. Thus there would be in the spermatogonium in all probability twenty-four chromosomes and eight chromatin nucleoli, in all thirty-two elements.

In the synapsis stage of the growth period the twenty-four chromosomes unite to form twelve bivalent ones. The eight chromatin nucleoli likewise combine to form four bivalent ones, which near the close of the growth period (Figs. 208, 209) are seen to be small bodies attached to the surface of the true nucleolus (*N*). Each is dumbbell-shaped, usually with its component univalent parts in close apposition, but occasionally the latter are more or less separated from one another.

Pole views of the monaster stage of the first maturation division (Fig. 210) show sixteen elements, namely, twelve larger, bivalent chromosomes (dumbbell-shaped on lateral view) and four much smaller chromatin nucleoli (*N. 2*). All these elements are halved in the following metakinesis, which is a transverse (reduction) division, and pole views of the daughter cells (second spermatocytes, Fig. 211) show twelve larger, univalent chromosomes and four smaller, univalent chromatin nucleoli (*N. 2*).

35. *Sinea diadema* Fabr.

Two testes of this species were studied.

The relations of the chromatin nucleoli in the rest stage of the spermatogonia could not be determined.

There were on my preparations only a few spermatogonic monaster stages, and none of these were favorable for determining the number of chromosomes; the chromosomes are small, densely grouped, and particularly minute elements among them might be chromatin nucleoli.

In the rest stage of the spermatocyte are present four small chromatin nucleoli (*N. 2*, Figs. 212, 213, Pl. V), all of them attached to the surface of a large true nucleolus (*N*). One is larger than the others, and appearing on lateral view to be always transversely constricted (Fig. 213) is probably bivalent; and as one of the three smaller ones is sometimes found to be bipartite, this too would be bivalent. The two remaining are apparently always spherical and not transversely constricted, so that they would seem to be univalent. If this interpretation is correct, there would be here two bivalent chromatin nucleoli each with its component parts closely apposed, and one bivalent one with its components separated, that is three bivalent ones in all; and in the first maturation division there are three chromatin nucleoli present (Figs. 214, 215), which would corroborate this conclusion. But since it could not be determined how many there are in the spermatogonia, the relations in the spermatocytes cannot be considered positively demonstrated.

Pole views of the monaster stage of the first maturation division (Figs. 214, 215) show always three minute chromatin elements, which are chromatin nucleoli (*N. 2*), and apparently thirteen larger chromosomes. But a careful examination of these larger elements shows that in every case four bivalent chromosomes form together a plurivalent one, all four being closely apposed and with their long axes parallel to one another. This is best seen on lateral view of the spindle (Figs. 217, 218), where the four chromosomes marked *t* are always found to be grouped close together; in Fig. 216 only these four chromosomes with their mantle fibre attachments are seen on lateral view. Of the four chromosomes thus grouped together, the two middle ones stand in the closest apposition (Fig. 216–218); and on pole views these two middle ones may be so closely apposed as to appear as one long one (*t*, Fig. 214), or a slight transverse constriction marks the division line between them (*t*, Fig. 215). It follows accordingly that the three elements seen on pole view and marked *t* are really four bivalent chromosomes, the two central ones being so closely apposed as to appear generally as one long one. A comparison of the elements designated *t* in Figs. 214 and 215 with the corresponding elements in Figs. 216–218 makes this evident. Accordingly there are really fourteen bivalent (dumbbell-shaped)

chromosomes present, four of which are always grouped together to form a particular group.

The metakinesis halves each of the fourteen bivalent chromosomes transversely (reduction division, Figs. 217, 218), but the four which together form the group that has been described divide later than the others, as can be seen from the figures given; and it is at this metaphase that this group of four can be most easily recognized. Such a group of four closely united bivalent chromosomes has not been found by me in any other Hemipteron.

36. *Prionidus cristatus* Linn.

Four testes of this species were studied.

In the rest stage of the spermatogonium there are apparently five chromatin nucleoli (*N. 2*, Figs. 220–222, Pl. V), two of which are generally considerably larger than the others, and some or all of which may be attached to the true nucleolus (*N*, Figs. 221, 222). But it is difficult to be sure of the exact number, for sometimes not more than four can be seen (Fig. 221).

In the spermatogonic monaster on pole views (Figs. 223, 224) are seen twenty-six chromatin elements, three of which (*N. 2*) are always much smaller and (by analogy with the other species of the *Reduviidæ*) would probably represent the three small chromatin nucleoli of the preceding rest stage. Two of the twenty-six chromatin elements are elongate in form and much larger than the others; these may be chromosomes (which would be more probable), or they might represent the large chromatin nucleoli of the rest stage of the spermatogonium. If there are really five chromatin nucleoli in the spermatogonia, then there would be these five elements and twenty-one chromosomes present in the spermatogonic mitosis. In five pole views I could count exactly twenty-six chromatin elements, in two there were either twenty-six or twenty-seven, and in one either twenty-four or twenty-five; but in all these cases three particularly small and two particularly large elements could be distinguished.

In the rest stage of the spermatocyte (Fig. 225) are found four chromatin nucleoli (*N. 2*) attached to the true nucleolus (*N*). One of these is longer than the others and rod-shaped, and may represent the two larger chromatin nucleoli of the spermatogonium joined into one bivalent one; the three smaller ones may appear rounded or slightly elongate, and these may represent the three small chromatin nucleoli of the spermatogonium; occasionally two of the small ones are apposed together.

There were no maturation mitoses on my preparations (from adults taken in the month of September).

37. *Milyas cinctus* Fabr.

In the single testis of this species studied (an individual of the month of September) there were no mitoses.

In the rest stage of the spermatocytes (Figs. 226–228) are found one long, rod-shaped chromatin nucleolus and two or three smaller ones (*N. 2*), all apposed to the true nucleolus (*N*). The long one is certainly bivalent, since it frequently shows a transverse constriction (Fig. 228) or is bent at the middle point (Fig. 227); on account of the length of each of its component parts it might be concluded that each of them is bivalent—*i. e.*, that the whole element is quadrivalent—but neither of the parts appear bipartite, so that this long chromatin nucleolus would more probably be bivalent. In those cases where only two smaller chromatin nucleoli are present (Fig. 228), each of them is clearly transversely constricted (bipartite) and hence bivalent; where three are present we find that one is bipartite and accordingly bivalent (Fig. 227), the other two are spherical and hence univalent. By comparing Figs. 227 and 228 we find that the two spherical chromatin nucleoli of the former would together represent one of the small bivalent chromatin nucleoli of the latter. Thus we may conclude that there are three bivalent chromatin nucleoli present in these spermatocytes, though the two components of one of them may be separated.

LIMNOBATIDÆ.

38. *Limnobates lineata* Say.

Of this small species I was able to procure the testes of only one (adult) individual. The only stages of spermatogenesis present were spermatocytes in the growth period.

In the large spermatocytes in the rest stage (Pl. V, Fig. 219) is found a large chromatin nucleolus (*N. 2*), usually apposed to the true nucleolus (*N*) in such a manner that the chromatin nucleolus touches with one pole the nuclear membrane, with the other the true nucleolus.

HYDROBATIDÆ.

39. *Hygotrechus* sp.

Twelve testes were studied of this species (from the vicinity of Philadelphia).

The relations of the chromatin nucleoli in the rest stage of the spermatogonia could not be determined, since the nuclei are very small at this stage.

The spermatogonic monaster shows on pole view (Pl. V, Fig. 229) exactly twenty chromatin elements, of which the eighteen largest are chromosomes and the two smallest (*N. 2*) probably chromatin nucleoli.

In the synapsis stage of the spermatocyte (Fig. 230) are seen two small chromatin

nucleoli (*N. 2*), which are not closely apposed; the true nucleolus (*N*) is much larger. In the rest stage the chromatin nucleoli are usually widely separated from one another, and on account of their small size are difficult to discover. In the growth period they do not stain bright red with the saffranine-gentian violet stain of Hermann, but deep violet, even on excellently stained preparations. Such a staining reaction as this I have not found for the chromatin nucleoli of other *Hemiptera*, for in all the other forms examined the chromatin nucleoli take the red saffranine stain intensely even while the chromosomes have taken the violet stain (in the rest stage). Perhaps in *Hygotrechus* the chromatin nucleoli differ chemically less from the chromosomes than in the other *Hemiptera*, and undergo in the growth period changes parallel to those of the chromosomes.

Pole views of the monaster stage of the first maturation division (Fig. 231) show always exactly eleven chromatin elements. On account of the number in the spermatogonia (twenty), I would interpret these as nine bivalent chromosomes, and two univalent chromatin nucleoli which are not combined into one bivalent one. This is very probable, since the two univalent chromatin nucleoli are often widely separated in the growth period; and on lateral views of the monaster stage of the first maturation division, there are found two bodies which are spherical and not dumbbell-shaped. On no lateral view of this monaster stage could I see all the nine chromosomes clearly; but in one case I saw eight of them, all clearly dumbbell-shaped (bipartite), so that probably all nine are bivalent. The first maturation division is reductional, as in the other *Hemiptera*.

40. *Limnotrechus marginatus* Say

Two testes of this species were studied.

There were no spermatogonic monaster stages present, and I could not determine the relations of the chromatin nucleoli in the rest stage of these cells.

In the rest stage of the spermatocyte (Pl. V, Fig. 232) is found a large true nucleolus (*N*), and separated from it, usually close to the nuclear membrane, a rounded chromatin nucleolus (*N. 2*).

Pole views of the first maturation monaster (Fig. 233) show eleven chromatin elements; sometimes one appears much smaller than the others, and it may represent the chromatin nucleolus.

NAUCORIDÆ.

41. *Pelocoris femorata* Pal. Beauv.

Fourteen testes of this species were studied from adult and half-grown individuals of different seasons of the year. There were an abundance of rest stages of spermatogonia and of spermatocytes in the growth period, but no maturation mitoses present.

The chromosomes were counted in a number of pole views of the monaster stage of the spermatogonia, but in most cases they were so densely grouped as to make the numbers obtained very uncertain. In the most favorable case (Pl. V, Fig. 234) apparently twenty chromatin elements are present, but I could not be certain of this number.

The relations of the chromatin nucleoli in the growth period are very puzzling. On preparations stained with Hermann's saffranine-gentian violet, there appear to be a variable number of rounded bodies of different volume which stain bright red; sometimes they are arranged in pairs, sometimes in long chains, sometimes they show no regular arrangement whatsoever. One nuclear body, much larger than the others and generally irregular in outline, may be a true nucleolus. If all the red-staining bodies are chromatin nucleoli, they would seem to be present in an unusually large number in this species. A study of further material will be necessary to explain the nature and relations of these bodies.

BELOSTOMATIDÆ.

42. *Zaitha* sp.

There are two species of this genus known in the vicinity of Philadelphia where I collected my material, namely, *Z. fluminea* Say and *Z. aurantiacum* (Leidy), but which species it was that I collected I omitted at the time to determine. Ten testes were examined.*

In the rest stage of the spermatogonium (Fig. 235) are present two small chromatin nucleoli (*N. 2*) apposed to a large true nucleolus (*N*).

Pole views of the spermatogonic monaster stage (Figs. 236, 237) show twenty-four chromatin elements, of which the smallest two (*N. 2*) represent the chromatin nucleoli, and the remaining twenty-two are chromosomes. Of the chromosomes, four are always elongate and much larger than the others (*t*, Figs. 236, 237).

In the synapsis stage of the growth period the twenty-two chromosomes unite to form eleven bivalent ones. In the rest stage of the spermatocytes there are two univalent chromatin nucleoli, sometimes joined to make a bivalent one, attached to the surface of the true nucleolus.

Pole views of the monaster stage of the first maturation division (Fig. 238) show

* In my "Note on the Genital Organs of Zaitha" (*American Naturalist*, Vol. xxxiv, 1900). I described the structure of these testes. To the text figure B given in that paper, I would add now that the earlier stages of spermatogenesis are to be found in what I called the "terminal fibres" at the proximal end of the testis, these fibres being five long and much convoluted slender tubes which interlace together and form a rounded whitish mass at the extreme proximal end of the testis; they were not correctly represented in the figure cited. In adult individuals it is only in this portion of the testis that the earlier spermatogenetic stages occur, all the rest of the testis being filled with spermatozoa. It is necessary to collect individuals in the month of May (shortly before the copulation), in order to obtain the stages of the maturation divisions.

always thirteen chromatin elements. Two of these are much smaller than the others (*N. 2*), and are obviously the univalent chromatin nucleoli, which at this stage do not make up a bivalent one. The eleven large elements are chromosomes, and since all of them appear dumbbell-shaped on lateral view, they are all bivalent. Two of the eleven chromosomes have a markedly greater volume than the others (*t 2*, Fig. 238), and these correspond to the four large chromosomes of the spermatogonia (*t*, Figs. 236, 237); that is to say, in the synapsis the four large chromosomes derived from the spermatogonia unite together to form two bivalent ones, and a large one never appears to unite with a small one.

The first maturation mitosis is a reduction division, and each daughter cell (second spermatocyte) receives eleven whole univalent chromosomes.

III. General Conclusions.

1. The process of spermatogenesis in the Hemiptera, and the individuality of the chromosomes.

In the *Hemiptera heteroptera* we find, as generally elsewhere in the *Metazoa*, a number of generations of spermatogonia in each of which all the chromatin elements are halved in metakinesis (apparently in all cases equationally), the last generation producing spermatocytes of the first order. These spermatocytes enter upon a growth period of long duration, which is followed by the first maturation division, resulting in the formation of spermatocytes of the second order; and in the second maturation division the spermatocytes of the second order are divided into spermatids. There are always exactly two maturation divisions and no more. The metamorphosis of the spermatids into the spermatozoa has not been studied by me, and has not the broad comparative interest of the preceding stages, but it has been described by Henking (1890) and Paulmier (1899).

The growth period of the spermatocytes is of the greatest interest, for here are a remarkable series of changes not found in any other generation of the germ cells nor, so far as is known, in any somatic cells. And the most important of these changes are found in the synapsis stage of the growth period. The synapsis stage is well-marked in all the *Hemiptera* examined by me without exception, characterized by a dense grouping of the chromatin loops; the citations given by me in my study on *Peripatus* (1901) show that it seems to be present in almost all, if not all the *Metazoa* in which the spermatogenesis and ovogenesis has been carefully examined. The dense grouping of the chromosomes in this stage is not an artifact produced by faulty fixation methods, as McClung (1900) has recently maintained, for exactly the same appearances are to be

found after the action of most diverse fixatives. The dense and interlacing grouping of the chromosomes that is so characteristic for the synapsis of Insects, Copepods, Ascaris and some other forms, is, however, not found in all; thus it does not appear to occur in *Salamandra* (Meves, 1896).

Moore (1895) first gave the name "synaptic phase" to that stage in the growth period of Elasmobranchs when the reduction in the number of the chromosomes takes place. Accordingly, the criterion of the synapsis stage is first of all the combination of univalent chromosomes to form bivalent ones; whether the chromosomes are then densely grouped or not is of secondary importance. A special chapter of the present paper is given to the broader significance of this stage.

In all the *Hemiptera* examined, and also in *Peripatus*, I have found that bivalent chromosomes are formed in the synapsis by a union, end to end, of every two univalent chromosomes. All other writers on this stage, with the exception of Brauer, have been unable to determine how the univalent chromosomes become united together; Brauer's (1893 b) careful study of the growth period in the spermatogenesis of *Ascaris* rendered it very probable that it is a union end to end, but his figures do not prove it absolutely. Certain writers state that the reduction of the number in chromosomes is effected by the chromatin spirem segmenting into only half the normal number of chromosomes. This is, however, an incorrect statement, inasmuch as the reduction in number is occasioned in some cases (*Hemiptera*, *Peripatus*) before the "spirem" stage of the first maturation division, and inasmuch as in most cases, if not all, there is no continuous *chromatin* spirem found at any time during the growth period and prophases of the first maturation mitosis.

Accordingly in the *Hemiptera* the reduction in number of the chromosomes is effected in the synapsis stage, a long while before the maturation divisions, by a union end to end of every two chromosomes. During the synapsis stage the chromosomes become split longitudinally, as was first shown by Paulmier (1898, 1899) for *Anasa*—a process that I had overlooked in my former paper (1898). Each bivalent chromosome is thus both transversely and longitudinally split before the maturation mitoses, the transverse split represented by the band of linin joining the approximated ends of the two univalent chromosomes.

At the close of the growth period there is a well-defined rest stage in most *Hemiptera*, when chromosomal boundaries are practically indistinguishable; but in the *Coreidæ* and *Reduviidæ* there appears to be no such stage, and accordingly such a stage would appear to have no broad significance.

In the early prophases of the maturation divisions the chromosomes are bivalent but quadripartite, each one being transversely and longitudinally split; in the later pro-

phases, up to the monaster stage of the first mitosis, the longitudinal split generally closes temporarily. The definitive form of these chromosomes in all the *Hemiptera* examined is that of a dumbbell which may be either straight or bent; ring forms are more infrequent, but are occasionally found in all species. In the *Hemiptera*, as in *Peripatus*, each ring may be conceived as a dumbbell which has become bent until its ends meet, and accordingly the hollow of the ring is not the longitudinal split, but a space separating the univalent chromosomes. That is to say, generally only one end of one univalent chromosome is joined to one end of the other, but in the ring form both ends of the one are joined with both ends of the other. In all bivalent chromosomes that have not the ring form a longitudinal axis can be plainly determined, and generally each univalent chromosome is elongated in the same line; the constriction perpendicular to this long axis is a true transverse division, and is the band of linin joining the ends of the two univalent chromosomes. This orientation of the axes of the bivalent chromosomes allows the positive determination of the manner in which the chromosomes are halved in the maturation divisions.

In the first maturation division in all the *Hemiptera* examined the bivalent chromosomes are transversely divided, *i. e.*, whole univalent chromosomes are separated; in the anaphase of this division the longitudinal split of the univalent chromosomes reappears, and in the second maturation mitosis the univalent chromosomes are halved through the plane of this split (equation division). The valences of the chromosomes in the successive generations are accordingly: *spermatogonium*, univalent; *first spermatocyte*, bivalent; *second spermatocyte*, univalent; *spermatid*, semivalent. The classing of the chromosomes as semivalent in the spermatid may appear surprising, for they have always been considered univalent; but they must be considered semivalent with reference to the number in the spermatogonia in those cases, as in all the *Hemiptera* examined, where the second maturation division follows immediately upon the first without any indication of an intermediate rest stage.

Thus in the *Hemiptera*, as in *Peripatus*, the maturation divisions do not accomplish the reduction in number of the chromosomes, for this takes place long before in the growth period; the first maturation division separates entire univalent chromosomes (*pseudoreduction*, Rückert, 1894), the second halves each univalent chromosome equationally, and thus halves the chromatin mass. Though the chromosomes of the spermatid are logically semivalent with reference to those in the spermatogonia, yet they are potentially univalent on account of the increase in mass of the chromatin during the growth period (where at least a doubling of the mass occurs).

In my study on *Peripatus* (1901) it was shown that the individuality of the chromosomes is maintained from the last spermatogonic mitosis up to and through the maturation

divisions; and in that paper I have referred to the observations of other workers corroborative of the individuality of the chromosomes, so that they need not be recalled here. In such *Hemiptera* as the *Coreidæ* there is no true rest stage in the growth period, so that definite chromosomal outlines can be determined throughout the growth period. And even in those *Hemiptera* where a rest stage does occur in this period, in which the chromosomes become reticular and practically indistinguishable from one another, all evidence renders it probable that the chromosomal individuality is retained through this period—*i. e.*, that a particular univalent chromosome of the maturation mitosis represents a particular one of the spermatogonia. This evidence is as follows: The chromatin nucleoli, which are only modified chromosomes, retain their compact form and so are readily distinguishable throughout all periods of these generations. Then in those cases where there is an uneven number of chromosomes in the spermatogonia, and the odd one remains univalent in the spermatocytes, this odd one can always be distinguished in the maturation mitoses. Then where two of the spermatogonic chromosomes are particularly large, there is always found in the first maturation mitosis one particularly large bivalent chromosome which can only correspond to those two. Further, after a rest stage there is always the same number of chromosomes as were present before that rest stage. All this evidence speaks for a chromosome of a spermatogonium corresponding to a chromosome of a spermatocyte; and if in these generations there is a maintenance of chromosomal individuality, there is a probability that there is such a maintenance through all generations of the germinal cycle. But this conclusion by no means implies that a chromosome of one generation is actually the same as a chromosome of another. For we know that each chromosome is halved in an equation division, and that each daughter chromosome so produced must increase to a volume equal to that of the mother chromosome before it enters upon a second mitosis. Thus new substance must continually be elaborated by the chromosomes during the rest stages, and in the course of this elaboration the old substance of the chromosome and its physical form are correspondingly changed. There is no evidence that chromosomal substance remains unchanged from generation to generation, for all evidence shows that it undergoes metabolic change and growth in the rest stages. But nevertheless it seems very probable that a chromosome of one generation is a derivative of a particular chromosome of the preceding generation, and that the chromosomes may thus be said to maintain themselves as entities through successive generations.

There are many cases where chromosomal boundaries are indistinguishable in the rest stages, so that in such cases it has been argued that the chromosomes show no individuality. But these are negative examples, and positive cases that speak for the maintenance of the chromosomal individuality must be considered as the decisive ones. No

other assumption can so well explain the maintenance of a constant number. The fact that the chromosomes build up new substance at one stage, and give off waste products at another, does not invalidate our conclusion. Those who deny the maintenance of chromosomal individuality, on the basis of a study of objects where the chromosomes do not appear to be continuous from generation to generation, are not justified in concluding that there is never a maintenance of the individuality until they have examined the positive cases. And since there have been shown to be positive cases, we must conclude (1) either that in all normal mitoses of the germinal cycle the chromosomal individuality is maintained, or (2) that it is preserved in some cases but not in others. The fact that it has been demonstrated for some cases renders it probable that is maintained in all cases, even though it cannot be demonstrated in all.

2. *The chromatin nucleoli.*

The term "chromatin nucleolus" was applied by me (1898) to the remarkable chromatin element, in form like a nucleolus but in behavior and staining reactions like a chromosome, in the nuclei of spermatocytes of *Euchistus* (*Pentatoma*); the name was given in order to denote this double similarity, though I fully realized that this structure was in all essentials a modified chromosome. A special monograph (1899 b) was devoted by me to the true nucleolus (plasmosome, Ogata) of Metazoan cells; and in a lecture at the Woods Holl laboratory (1898 b) I classified the other "nucleolar" structures as "karyosomes, which are merely thickened nodal points of the chromatin reticulum; further, what I shall term the 'chromatin-nucleus' [typographical error for 'chromatin nucleolus'], which is found in certain spermatocytes; and then various structures which stain neither like the true nucleolus nor the chromatin, and to which such terms as 'Paramcleoli,' 'Nebennucleoli,' and 'Pseudonucleoli' have been applied. It is one of the most difficult questions to determine the nature and correspondence of the latter structures. . . . . But from the cases studied by me, it would appear that some of these structures in *Metazoa* probably must be placed within the category of true nucleoli, and be regarded as true nucleoli of a different chemical nature; . . . . our criterion of nucleoli probably should not be based as much upon chemical as morphological facts."

The chromatin nucleolus is a modified chromosome, as both my earlier and the present observations show. The term may have been injudiciously chosen, since I myself showed that it has nothing in common with a true nucleolus except sometimes in the form and in containing vacuoles. In its stead McClung (1899) has given the name "accessory chromosome," and Paulmier (1899) the name "small chromosome." But McClung's term is not satisfactory in not being at all definite, and Paulmier's term is not

applicable to those cases where it is as large as the other chromosomes. Hence I consider that confusion in terminology would be best avoided by retaining my original term, "chromatin nucleolus."

In my first description of the spermatogenesis of *Euchistus* (1898 a), I stated that I could not find chromatin nucleoli in spermatogonia, and that one appeared for the first time in the spermatocyte by a metamorphosis of one of the fourteen chromosomes; this was an error that I have corrected in the present paper, for in *Euchistus*, just as Paulmier (1899) correctly described for *Anasa*, there are two chromatin nucleoli in the spermatogonium, and these unite in the spermatocyte to form one bivalent one. And in all the *Hemiptera* examined by me the larger chromatin nucleoli of the spermatocytes are derivatives of chromatin nucleoli of the spermatogonia, except the remarkable "chromosome x" of *Protenor*, to which we shall return. As far as I have been able to determine, the chromatin nucleoli are always halved in the mitoses of the spermatogonia.

(a) *General Characteristics.*

The chromatin nucleoli are morphologically chromosomes, undergoing division in mitosis like the other chromosomes, but differing from them in the rest stage by preserving a definite (usually rounded) form. There is also another difference which is of great use in their study: by the use of the double stain of Hermann, saffranine and gentian violet, the chromosomes proper stain red only in mitosis and violet in the rest stage, while the chromatin nucloli stain red in the rest stage also, and so can be sharply distinguished from the chromatin of the chromosomes.* Thus the chromatin nucleoli of the *Hemiptera* seem to retain at all stages the stain characteristic for the substance of the chromosomes when in the height of mitosis. In the *Hemiptera* examined the true nucleoli never takes this red stain, but take the violet, so that they may in this way be easily distinguished from the chromatin nucleoli.† With iron-hæmatoxylin staining the chromatin nucleoli stain more intensely than the chromosomes in the rest stage; but with this stain the true nucleoli generally stain deep black like the chromatin nucleoli, so that it is far less satisfactory than the preceding method for differentiating these two structures. With the triple stain of Ehrlich-Biondi-Heidenhain, the chromatin nucleoli

* The only exception to this staining reaction was found in the spermatocytes of *Hygotrechus*, where in the rest stage the chromatin nucleoli always take the violet stain.

† However, in cells of many other *Metazoa* I have found that the true nucleoli show a particular electivity for the saffranine, so that chemical reactions are not tests for true nucleoli; nucleoli may differ chemically from one another, even in the same cell at the same stage, or at different stages, and no better case of this may be mentioned than the ovocytes of the growth period of *Gryllus*. In the *Hemiptera* the true nucleoli are generally much larger than the chromatin nucleoli, more or less irregular in outline, and they usually occupy a more or less central position in the nucleus (though I have mentioned two or three exceptions), while the chromatin nucleoli in the spermatocytes are generally in contact with the nuclear membrane.

and chromosomes in the rest stage are green, the true nucleoli red; with Delafield's hæmatoxylin and eosin, the chromatin nucleoli and chromosomes stain blue, the true nucleolus red; with both these methods the chromatin nucleoli stain more intensely than the chromosomes in the rest stage.

In the spermatogonia the chromatin nucleoli are generally small, often very minute and difficult to distinguish. They are apparently always halved in the spermatogonic mitoses, though I have not been able to determine this for all species. They always increase in volume during the growth period of the spermatocytes; the relative amount of this increase varies in different species, but it is a number of times greater than in the spermatogonia. During this increase in mass there can be found in most cases a clear vacuole in the chromatin nucleolus, so that the increase would appear to be not so much one of the proper substance of the chromatin nucleolus as of an intussusception of fluid from without; I have not figured these vacuoles in the present paper, but showed them in a preceding one (1898 a). In the prophases of the first maturation division the chromatin nucleolus decreases very considerably in volume, until when the monaster stage is reached its volume may be very little greater than in the spermatogonia. It is possible that its increase in mass during the growth period may be due in part to a decondensation of its substance, but in some part at least it is due to the above-described taking in of fluid substance from without.

In the spermatogonia they are irregular in position, sometimes close together, sometimes separated, but usually not in contact with the nuclear membrane; in these cells they are very frequently in all species apposed to the true nucleoli.* In the growth period of the spermatocytes they are more regular in position: thus they are separated from the true nucleoli and then always in contact with the nuclear membrane in *Euchistus, Mormidia, Peribalus, Cosmopepla, Nezara, Brochymena, Trichopepla, Eurygaster, Metapodius, Anasa, Chariesterus* (generally), *Corizus, Harmostes, Calocoris, Hygotrechus, Limnotrechus;* they are, as a rule, apposed to the true nucleoli in *Podisus, Perillus, Cœnus, Alydus, Protenor, Peliopelta* (not always), *Œdancala, Oncopeltus* (not always), *Leptopterna, Pœcilocapsus, Phymata, Coriscus*, the *Reduviidæ, Limnobates* and *Zaitha.* We shall refer again to the significance of this apposition. A chromatin nucleolus and a true nucleolus closely attached together constitute a "double nucleolus;" it remains to be shown whether the "double nucleoli" of certain cells of other *Metazoa*, as *e. g.* in the cells of Sertoli of *Salamandra* and *Mus*, as described by Hermann and others, may also be cases of apposed chromatin nucleoli and true nucleoli. It is very characteristic of the chromatin nucleoli of the spermatocytes in the growth period to be closely apposed to the nuclear membrane. And when they are apposed to true nucleoli,

* In the spermatogonia there are in all species an irregular number of true nucleoli, but in the spermatocytes of most of the species examined there is regularly one large one.

they retain this position if they are of comparatively large size (as in most *Pentatomidæ*) but do not when they are of comparatively small size (as particularly in the *Reduviidæ*). Now the true nucleolus is rarely in contact with the nuclear membrane when it is not apposed to a chromatin nucleolus, so that when the two are mutually apposed it appears to depend upon their relative volumes whether they will be peripheral or central in position—a very large chromatin nucleolus pulling to the periphery the true nucleolus, a small chromatin nucleolus being pulled by the true nucleolus toward the centre of the nucleus.

That the chromatin nucleoli are morphologically chromosomes is shown particularly in mitosis, when they simulate in form and divide like chromosomes; an examination of the chromatin nucleoli, designated *N. 2*, in the plates of the present paper, demonstrate this point. The univalent chromatin nucleoli of the spermatogonia generally unite to form bivalent ones in the synapsis stage just as do the chromosomes, and generally the number of them in the spermatocytes is just half of that in the spermatogonia (certain exceptions shall be considered later). In the first maturation division each bivalent chromatin nucleolus is halved transversely (reduction division) just as are the bivalent chromosomes.

Thus the chromatin nucleoli are essentially chromosomes, but chromosomes which preserve a compact form and dense structure throughout the rest period.

(b) *Number and Valence.*

It is most frequently the case that there are two univalent chromatin nucleoli in the spermatogonia, as in the *Pentatomidæ, Eurygaster, Coreidæ, Peliopelta, Œdancala, Phymata, Coriscus* (?), *Hygotrechus, Zaitha.* In these cases the two chromatin nucleoli join together to form one bivalent one in the growth period; but in *Euchistus tristigmus* and *Chariesterus* the two frequently remain separate in the growth period, yet this is not a complete separation for there would seem to be a linin connection between the two, since they generally become more closely approximated at the time of the first maturation division when such a linin connection may be seen. But in some of these species (*Peribalus, Cœnus, Trichopepla, Coriscus*) besides the bivalent one are found one or two (three or four in *Trichopepla*) much smaller ones, which appear to be univalent, in the spermatocytes; whether these are represented in the spermatogonia or whether they arise in the spermatocytes for the first time, I could not determine on account of their minuteness.

In *Cymus* and *Ichnodemus* I could not determine the number in the spermatogonia, but since here there is one bivalent one in the spermatocytes, there would probably be two univalent ones in the spermatogonia. The same would probably be true for *Corizus* and *Leptopterna.*

The *Reduviidæ* and certain *Capsidæ* show a larger number of chromatin nucleoli.

Thus in *Acholla* there are eight in the spermatogonia which form four bivalent ones in the spermatocytes; in *Sinea* and *Milyas* there are three bivalent ones in the spermatocytes, and accordingly probably six in the spermatogonia; in *Prionidus* there are apparently five in the spermatogonia, two of which unite in the spermatocytes to make one bivalent one while the three others remain univalent. In *Calocoris* there are in the spermatocytes two bivalent and one univalent; in *Pœcilocapsus lineatus*, one bivalent and one apparently univalent; in *P. goniphorus* certainly four, and possibly five, bivalent chromatin nucleoli in the spermatocytes. In these forms one or more of the chromatin nucleoli may have their component parts more or less widely separated, but these separated components generally come together before the first maturation mitosis.

Bivalent chromatin nucleoli which have their components in close mutual apposition appear always to be transversely divided in the first maturation division (reduction division); for the behavior of those which are univalent I refer to the chapter on "Observations."

Oncopeltus affords the interesting case where the two chromatin nucleoli of the spermatogonia are apparently each bivalent—bivalent elements in a generation where all the chromatin elements are usually supposed to be univalent.

(c) *The Peculiar Chromosome of Protenor.*

In *Protenor*—for the details compare the description in the chapter on "Observations"—there are two chromatin nucleoli in the spermatogonia, which in the spermatocytes unite to form a bivalent one, as we have just seen to be quite generally the rule in *Hemiptera*. But the largest of the chromosomes of the spermatogonic mitoses, the "chromosome x," does not behave in the growth period of the spermotocytes like the other chromosomes, but is similar to a chromatin nucleolus in preserving a compact form and in retaining the saffranine stain. This is the odd chromosome, the eleventh, which does not combine with any other during the synapsis stage, and which cannot be distinguished in the rest stage of the spermatogonia because there it behaves exactly like the other chromosomes, and takes part in the formation of the nuclear reticulum. This is the only case in the *Hemiptera* where one chromosome becomes differentiated into a chromatin nucleolus for the first time in the spermatocyte generation, unless the minute chromatin nucleoli of *Peribalus, Cœnus, Trichopepla* and *Coriscus* may be found to have a similar history.

(d) *Function.*

All the observations show that the chromatin nucleoli are modified chromosomes, which behave essentially like the chromosomes in mitosis but quite differently in the rest stage.

Paulmier (1899) has suggested that they are degenerate chromosomes. This would

seem to be true to some extent, but not wholly correct for the following reasons. In a large number of the species examined the chromatin nucleoli are regularly closely apposed to the surfaces of true nucleoli. Now it seems probable that the true nucleoli are masses of substances formed by the metabolism of the cell, probably waste substances (Montgomery, 1899 b). When we find accordingly the mutual apposition of them to chromatin nucleoli, it would be permissible to conclude that the chromatin nucleoli are chromosomes which are especially concerned with nucleolar metabolism. And this I think would be the correct interpretation. The chromatin nucleoli are in that sense degenerate, that they no longer behave like the other chromosomes in the rest stages; but they would appear to be specialized for a metabolic function. Thus it might be that in the Insects the chromatin nucleoli are those chromosomes which either exert a greater metabolic activity than the other chromosomes, or which carry out some special kind of metabolism; and from this point of view they would certainly seem to be much more than degenerate organs. As to their origin, compare the chapter on the "Number of Chromosomes."

Like the chromosomes, the number of chromatin nucleoli in the germ cells appears to be a fixed one for the species. In somatic cells they are often more numerous than in the germ cells, however, but that somatic difference will not be discussed in this paper which concerns itself with the germinal cycle.

(e) *Occurrence.*

Chromatin nucleoli were found by me in all the *Hemiptera* examined, and I have found them also in *Coleoptera* (*Harpalus*) and *Orthoptera* (*Gryllus, Ceutophilus*). McClung (1899, 1900) has described them in various *Orthoptera*, in some forms of which they are larger than the chromosomes. Finally, my student, Miss Wallace (1900), has found them in the spermatogenesis of a spider (Agalenid).

Accordingly they would seem to be present in the Insects and Arachnids, but are apparently absent in the *Crustacea*, and I have shown (1901) that they are not present in *Peripatus*.

It is, however, quite possible that they will be discovered in other forms, if proper attention is paid to them. The question of their ontogenetic origin will be considered later (compare the section on the "Significance of the uneven number" of chromosomes).

3. *The Number of Chromosomes.*

The following table shows the number and valence of the chromosomes and chromatin nucleoli in the *Hemiptera* examined, all of which has been explained in detail in the chapter on "Observations." The abbreviation "*univ.*" has been employed for "univalent," and "*biv.*" for "bivalent."

Species.	Spermatogonia.				Spermatocytes.			
	Chromosomes.		Chromatin nucleoli.		Chromosomes.		Chromatin nucleoli.	
	No.	Valence.	No.	Valence.	No.	Valence.	No.	Valence.
Euchistus variolarius	14	univ.	2	univ.	7	biv.	1	biv.
E. tristigmus	12	univ.	2	univ.	6	biv.	1 or 2	biv. or univ.
Podisus spinosus	14	univ.	2	univ.	7	biv.	1	biv.
Mormidea lugens	14	univ.	2	univ.	7	biv.	1	biv.
Peribalus limbolaris	14	univ.	2	univ	7	biv.	1	biv.
Cosmopepla carnifex	16	univ.	2	univ.	8	biv.	1	biv.
Nezara hilaris	14	univ.	2	univ.	.....	.....	.....	.....
Brochymena sp.	14	univ.	2	univ.	7	biv.	1	biv.
Perillus confluens	14	univ.	2	univ.	7	biv.	1	biv.
Cœnus delius	12	univ.	2	univ.	6	biv.	2	1 biv. 1 univ.
Trichopepla semivittata	14	univ.	2	univ.	7	biv.	4 or 5	1 biv. 3 or 4 univ.
Eurygaster alternatus	.....	.....	.....	.....	6	biv.	1	biv.
Anasa tristis	20	univ.	2	univ.	10	biv.	1	biv.
A. armigera	20	univ.	2	univ.	10	biv.	1	biv.
A. sp	20	univ.	2	univ.	10	biv.	1	biv.
Metapodius terminalis	20	univ.	2	univ.	10	biv.	1	biv.
Chariesterus antennator	.....	.....	.....	.....	12	biv.	1	biv.
Alydus pilosulus	12	univ.	2	univ.	6	biv.	1	biv.
A. eurinus	11	univ.	2	univ	6	5 biv. 1 univ.	1	biv.
Corizus lateralis	.....	.....	.....	.....	6	biv.	2 or 3	1 biv. 1 or 2 univ.
Harmostes reflexulus	11	univ.	2	univ.	6	5 biv. 1 univ.	1	biv.
Protenor belfragei	11	10 univ. 1 biv.	2	univ.	5	biv.	2	biv.
Cymus angustatus	.....	.....	.....	.....	12	biv. (all?)	1	biv.
Ichnodemus falicus	14	univ.	2	univ.	7	biv.	2 or 3	?
Peliopelta abbreviata	14	univ.	2	univ.	7	biv.	1	biv.
Œdancala dorsalis	11	univ.	2	univ.	6	5 biv. 1 univ.	1	biv.
Oncopeltus fasciatus	14	univ.	2	biv.	7	biv.	2	biv.
Leptopterna dolabrata	.....	.....	.....	.....	16	biv.	1	biv.
Calocoris rapidus	28?	univ.	5?	univ.	14	biv.	3	2 biv. 1 univ.
Pœcilocapsus lineatus	.....	.....	.....	.....	16?	biv.	2	1 biv. 1 univ.
P. goniphorus	.....	.....	.....	.....	17? 14?	biv.	4	biv.
Phymata sp.	28	univ.	2	univ.	14	biv.	1	biv.
Coriscus ferus	.....	.....	.....	.....	9	biv.	2	1 biv. 2 univ.
Acholla multispinosa	24	univ.	8	univ.	12	biv.	4	biv.
Sinea diadema	.....	.....	.....	.....	14	biv.	3	biv.

Species.	Spermatogonia.				Spermatocytes.			
	Chromosomes.		Chromatin nucleoli.		Chromosomes.		Chromatin nucleoli.	
	No.	Valence.	No.	Valence.	No.	Valence.	No.	Valence.
Prionidus cristatus?	21?	?	5?	univ.	.....	.....	.....	.....
Milyas cinctus	.....	.....	.....	.....	.....	.....	3	biv.
Limnobates lineata	.....	.....	.....	.....	.....	.....	1	biv.
Hygotrechus sp.	18	univ.	2	univ.	9	biv.	2	univ.
Limnotrechus marginatus	.....	.....	.....	.....	10?	biv.	1?	biv.?
Pelocoris femorata	20?	.....	.....	.....	.....	.....	.....	.....
Zaitha sp.	22	univ.	2	univ.	11	biv.	2	univ.

The following general deductions may be drawn from the consideration of these facts. Whenever there is an even number of univalent chromosomes in the spermatogonia, they unite in the synapsis to produce exactly half this number of bivalent chromosomes. When there is an uneven number in the spermatogonia (*Alydus eurinus*, *Harmostes*, *Protenor*, *Œdancala*) all but one of the chromosomes unite in the synapsis to form bivalent chromosomes, while the odd one remains single.

(a) *Number and Genetic Relationship.*

At the outset of the present study I was particularly interested to determine whether the numbers of chromosomes might afford clues to the relationship of the group of the *Hemiptera heteroptera;* that is, to learn, if possible, whether the number would afford a taxonomic criterion. Most of the families of the *Hemiptera* are very rich in species, however, and I have been able to procure only a few species for study, so that the present beginning must be continued on many more species before any conclusion can be reached.

In the *Pentatomidæ*, counting the chromosomes in the spermatogonia, and not including the chromatin nucleoli, we find the number varies between twelve and sixteen, fourteen being most usual; in the *Coreidæ* we find twenty in *Anasa* and *Metapodius*, in *Alydus* eleven and twelve, in *Harmostes* and *Protenor* eleven. In the *Lygæidæ*, fourteen in *Ichnodemus*, *Peliopelta* and *Oncopeltus*, eleven in *Œdancala*, and probably twenty-four in *Cymus*. These were the three families of which the most species were examined. From these numbers it will be seen that there is considerable variation in number for the different species of one and the same family. Accordingly we must conclude either (1) that the number of chromosomes is easily modified and changed, so that it has little

taxonomic value; or (2), that the families of the *Hemiptera heteroptera*, as they are at present defined, are artificial and not natural groups. I would incline to the latter view, since all our facts would show that chromosomes are very conservative structures, and that the germinal cycle is conservative; probably the soma may be modified by the action of the environment to considerable extent, before any such action would produce a change in the number of chromosomes. If this standpoint is correct, then the number of the chromosomes would be a very important consideration in deciding the relationship of species; thus the *Coreida* would have to be subdivided into a sub-group with twenty to twenty-four chromosomes (*Anasa*, *Metapodius*, *Chariesterus*), and into one with eleven or twelve chromosomes (*Alydus*, *Corizus*, *Harmostes*, *Protenor*). But it would be a *reductio ad absurdum* to say that all forms with twelve chromosomes must be related, or all forms with twenty; the relative boundaries of a family must still be determined from the standpoint of broad comparative anatomy, and then within a group so defined the chromosomal number might be used as a basis for further subdivision.

(b) *Factors Determining the Number.*

A problem of great importance, and one that would seem to lie close to the root of all nuclear phenomena, is that concerning the factors which determine the number of chromosomes. The germ cells of each species have a fixed number of chromosomes, but different species show a very different number, from *Ascaris megalocephala univalens* with 2 up to *Artemia* with about 180. What is it that determines this numerical difference? A consideration of the various thinkable factors allows us to limit the problem somewhat, by excluding certain ones which are not real factors. Here we may consider in what relation to chromosomal number stand centrosomes and achromatic spindle elements, number of nucleoli, mass of nucleus and cell body, form of cell, volume and form of chromosomes.

The size, number and specific peculiarities of the centrosomes seem to have no connection with the number of the chromosomes. The definite number of chromosomes appears in the prophases of mitosis while the nuclear membrane is still intact, and when the centrosomes are only commencing to exert an influence upon the other cell constituents. Even the longitudinal splitting of the chromosomes would appear to be an automatic movement on their part. The centrosomes may well be centres of movements which produce the separation of the daughter chromosomes, but there appears to be no correlation between the centrosomes and the chromosomal number. And this seems also to be the case with regard to the spindle fibres. Central spindle fibres and polar radiations may vary in their phenomena in different generations of the same species, but the number of the chromosomes remains constant in all generations of the germ cells, for the apparent

halving of the number just before the maturation mitoses is not a real halving of the normal number, but only a grouping into pairs. And the mantle fibres, those which connect the centrosomes with the chromosomes, seem in fact to have their number determined to some extent by the number of the chromosomes, and not to determine that number, for the definite number of chromosomes appear in mitosis before the mantle fibres arise. The number of the connective fibres, those which connect corresponding daughter chromosomes in the anaphase, is certainly determined by the number of the chromosomes, for these fibres are stretched-out portions of the linin matrices of the chromosomes. Thus the centrosomes and the achromatic spindle structures may play a part in the distribution of the chromosomes, but apparently have no part in the determination of their number.

As for the true nucleoli, their number, volume and position seem to be in no way regulative of the chromosomal number. The nucleolar number in one species is generally variable, and correlatively also the volume and position, while the chromosomal number is constant; in the paternal germ cells the number of nucleoli is frequently different (and generally smaller) than that in the maternal cells of a species, but in both kind of cells the number of chromosomes is the same.

The mass of the nucleus or of the cell body, or the relative mass of the two, might seem *à priori* to stand in connection with the chromosomal number, yet an examination of the facts shows this is probably not the case. For instance, in one species the huge ovocytes and the much smaller spermatocytes have the same number of chromosomes, and a small ovogonium has the same number of chromosomes as a large ovocyte. And in the case of the ovocyte the volume of the nucleus is relatively small, in the spermatocyte relatively large in proportion to the mass of the cell body, yet the number of the chromosomes is the same. The mass of the chromatin substance may be more or less proportionate to the volume of the nucleus, but the number of the chromosomes appears not to be; the large number of chromosomes in *Artemia* (as determined by Brauer) is not correlated with a large nucleus; and as the figures of the present paper show, cells of approximately the same size from different species may show very different chromosomal numbers. The form of the cell is regulated to great extent by external influences, and variations in the form produce no modification of the chromosomal number.

The volume of the chromosomes in mitosis is dependent upon their number, since the volume of the chromatin stands in more or less direct ratio to the volume of the nucleus. The form of the chromosomes is more or less dependent upon their number, inasmuch as long ribbon-shaped chromosomes occur only where there are a small number, and rounded ones where there are a larger number present. Yet in all the *Hemiptera*, with their considerable differences in chromosomal number, the form of the chromosomes

remains quite constant, each univalent chromosome being generally slightly elongate. Thus the form is not wholly dependent upon the number, but particular groups of *Metazoa* appear characterized by particular forms of chromosomes, as *e. g.* the *Mollusca* with their rod-shaped chromosomes. Then the form of bivalent chromosomes is dependent upon the mode of junction of the component univalent elements. In no sense, however, can the form of the chromosomes be said to determine their number.

So far our considerations lead to only negative results; centrosomes and achromatic spindle structures, nucleoli, absolute and relative mass of nucleus and cytoplasm, cell form and chromosomal form seem not to be factors determining the number of chromosomes. As I attempted to show in a preceding paper on *Peripatus* (1901), the chromosomes must be regarded as individuals of a lower grade than what I termed the "nuclear element," namely, the linin spirem with the chromosomes arranged upon it. The problem is really, then, why does this nuclear element show in one species a certain number of chromatin segregations, in another species a different number? The more recent chemico-physiological studies would tend to show that the chromosomes are centres of metabolic activity, and accordingly the problem of the factors governing the chromosomal number may be closely connected with the phenomena of metabolism; the number of the chromosomes may be dependent upon the nature of the metabolism, as upon either the chemical nature of the chromosomes themselves or upon that of the cell nutriment. The latter might be experimentally tested by changing the food of a species, and observing whether differences in the number of the chromosomes might thereby be obtained. But to conclude that the number of the chromosomes is dependent upon the nature of the metabolism does not solve the problem but only states it more precisely.

Another question which arises in this connection is whether a small or a large number of chromosomes is to be regarded as the primitive condition. *À priori* it would appear probable that at an early phyletic period the number of chromosomes was not fixed for the species but variable, and that by a process of natural selection the number gradually became fixed. But as a species gradually changes into another form the number of chromosomes may also be changed, as will be shown in the next section, so that we may speak of an evolution of the number of chromosomes. On the principle of the law of greater condensation of organs in progressing evolution, it might be that a large number of chromosomes represents a more primitive condition than a smaller number. Within such a group as the *Hemiptera heteroptera*, for instance, forms like the *Belostomatidæ*, *Reduviidæ*, *Capsidæ* and *Phymatidæ* would be primitive in possessing a larger number of chromosomes, while the *Pentatomidæ*, *Scutellariidæ* and *Lygæidæ* in possessing a smaller number should be regarded as more specialized—more highly developed. From such a standpoint as this, the chromosomal number would be of taxonomic

value—it would be a signboard of degree of specialization within the group. From such a point of view it might even be possible to construct a cellular classification which would have great value in that it would employ truly conservative structures. The centrosomes and central spindles have been considered phyletically in this way by Bütschli, Lauterborn, Heidenhain, Calkins and others, but so far the chromosomes have not been considered from such a standpoint, although they in many respects appear more conservative than centrosomes and achromatic spindle structures.

Accordingly, though the present study has not given a solution to the problem of the factors governing the number of chromosomes, except in showing that it must be sought in the phenomena of metabolism, yet it would show that chromosomal number may be employed as a criterion of relationship if it be used with caution and with due consideration of a broad comparative treatment of other structures. And the reason is because the chromosomes seem to be highly conservative, their number constant for the species, and because in a certain sense they represent the most important vital structures. We should not conclude that all forms with *e. g.* ten chromosomes should be ranked as closely related; all with *e. g.* twenty-four as composing another natural group. But within a certain group which has been defined on a broadly comparative basis—such a group as the *Hemiptera heteroptera*—for instance, the chromosomal number would perhaps be a clue to the relative degree of specialization of the species.

(e) *Significance of the uneven normal number.*

One of the most unexpected results of this investigation was the discovery that in some species there is an uneven number of chromosomes in the spermatogonia, *i. e.*, an uneven normal number, whereas heretofore all observation and assumption has been that the normal number is always an even one. Of the *Hemiptera* studied, four species show an uneven number of chromosomes in the spermatogonia, namely, *Alydus eurinus, Harmostes reflexulus, Protenor belfragei* and *Œdancala dorsalis;* in all of these the number is eleven, and in the synapsis stage one chromosome remains univalent while the ten remaining combine to form five bivalent chromosomes. What is the significance and origin of this uneven number?

Now, as far as our facts go, it seems that the number of the chromosomes is constant for the species, and that the paternal and maternal germ cells of a species have the same number; this appears to be one of the points in the correspondence of the ovogenesis and spermatogenesis first determined by Henking (1890) and O. Hertwig (1890). Whenever there is this correspondence in number and valence, then in fertilization, when the paternal chromosomes are added to the maternal, an even number of chromosomes should result, and if the chromosomes maintain their individuality through the succeed-

ing generations, there should be an even number in the spermatogonia and ovogonia. The uneven number discovered in the four species mentioned may have arisen in one of two ways: through bastardization, or through a mitotic abnormality, each of which possibilities may now be considered.

In the case of bastardization of a germ cell with one chromosomal number by a germ cell from another species with a different number, the uneven number eleven might be secured if a paternal germ cell of a species *A*, with the normal chromosomal number twelve, fertilizes a maternal germ cell of a species *B* with the normal number ten. In species *A* the reduction in number of the chromosomes would give six univalent chromosomes in the spermatid, and in species *B* five univalent chromosomes in the matured ovum; conjugation of the two cells would then result in $6 + 5 = 11$ univalent chromosomes. In this way an uneven chromosomal number may have arisen by the conjugation of the germ cells of species with different numbers of chromosomes. But the objection to this view lies in the fact that hybridization of distinct species is generally infertile, and species which would have different chromosomal numbers would probably be quite distinct.

More probably, then, the uneven number may have originated through abnormalities of mitosis, and there would be many possibilities for such an occurrence. (1) It may have arisen in a spermatogonic mitosis, in a species where the ancestral normal number is twelve, by the chromatin of the spirem segregating abnormally into only eleven chromosomes, so that one of these chromosomes would be virtually bivalent. This would seem to have been the origin of the large odd chromosome *x* of *Protenor belfragei*, which appears bipartite in the spermatogonia and also in the spermatocytes, though in the latter it does not conjugate with any other chromosome. Such a case would be a deficiency in the segregation of the chromatin in the prophases of mitosis. (2) Or the uneven chromosomal number may have arisen by an unequal distribution of the chromosomes in the anaphases of mitosis, so that the daughter cells would not receive equal numbers.

Now, whether the uneven chromosomal number had originated through bastardization, or, what would be more probable, through abnormality in mitosis, it is interesting to determine how this number can perpetuate itself through different generations of the species, for my observations show that in the species where it is found it occurs in all individuals. The following table gives in condensed form the mode of reduction of the chromosomal number and valence in the four species in question, the chromatin nucleoli being omitted for the sake of simplicity:

Species.	Spermatogonium.	First Spermatocyte.	Second Spermatocyte.	Spermatid.
Alydus eurinus.	11 univalent.	5 bivalent. 1 univalent.	5 univalent. 1 semivalent.	5 or 6 semivalent.
Harmostes reflexulus.	11 univalent.	5 bivalent. 1 univalent.	5 univalent. 1 semivalent.	5 or 6 semivalent.
Protenor belfragei.	10 univalent. 1 bivalent.	5 bivalent. 1 bivalent.	5 univalent. 1 univalent.	5 semivalent. 1 or 0 univalent.
Œdancala dorsalis.	11 univalent.	5 bivalent. 1 univalent.	5 univalent. 1 semivalent.	5 semivalent. 1 (or 0 ?) semivalent.

It may appear strange that the chromosomes of the spermatids are classed as semivalent since they are generally considered univalent; as I have explained in an earlier portion of this paper, however, they must be regarded as semivalent on account of the absence of a rest stage between the maturation mitoses, though they are virtually univalent on account of their increase in mass during the growth period. *Protenor belfragei* differs from the three other species in showing a bivalent chromosome in the spermatogonium, which chromosome is consequently bivalent in the first spermatocyte even though it unites with no other during the synapsis stage. All four species have in common the phenomenon that the odd chromosome does not conjugate with any other during the synapsis stage, but remains separate. In *Alydus eurinus*, *Harmostes reflexulus*, and *Protenor belfragei* this odd chromosome does not divide in the second maturation mitosis, but passes undivided into one of the two spermatids. In *Œdancala dorsalis* I was unable to determine its behavior in this mitosis, though I have no reason to suppose that here it behaves differently from the other species. This unequal distribution of the odd chromosome in the second maturation mitosis is evidently in some way dependent upon its not having united with a fellow-chromosome during the preceding synapsis stage. What concerns us particularly at present is the fact that in these species with an uneven normal number of chromosomes, unlike those with an even number, one chromosome (the odd one) is not divided in the second maturation mitosis, but passes undivided into one of the daughter cells (spermatids); half of the spermatids then have six chromosomes and half have only five.

Bearing this point in mind, let us see how the uneven chromosomal number may be perpetuated from individual to individual. This may be occasioned by one of two possibilities. (1) The paternal germ cells having eleven chromosomes in the spermatogonia and either five or six in the spermatids, there is the probability that the maternal germ cells (ova) may have a corresponding number of chromosomes. If a spermatozoon with

five (or six) chromosomes conjugates with an ovum with five (or six), so that each of the conjoints has the same number, an even number would result in the fertilized ovum. But if a spermatozoon with five (or six) chromosomes unite with an ovum with six (or five), the conjoints having then different numbers of chromosomes, the fertilized ovum would have the uneven number eleven; the uneven number would then be perpetuated from individual to individual, so long as the conjugating cells have different numbers of chromosomes, and so long as the odd chromosome does not divide in one of the maturation mitoses. (2) Or germ cells from individuals with an uneven normal number of chromosomes, by conjugating with germ cells from individuals with an even number, would occasion an uneven number in the fertilized ovum. Either of these possibilities would suffice to explain the transference of the uneven number from individual to individual, though the first possibility would appear the more probable.

So far we have considered the origin of the uneven chromosomal number and the mode by which it is perpetuated from individual to individual. We have now to discuss its significance. Most of the *Hemiptera* examined by me show an even normal number of chromosomes; only four showed an uneven number, and in no other *Metazoa* has an uneven number, to my knowledge, been found. The uneven number would accordingly appear to be unusual. It seems to me probable that the uneven number represents a transition stage between a higher number and a lower, or the converse, and it is unusual because the transition stage is probably shorter than the earlier and the later stages. The number of the chromosomes varies quite considerably in the different species of the *Hemiptera heteroptera*, but we cannot suppose that the number was constant for each species from the beginning any more than we can consider that the species have always remained unchanged; there must have been an evolution of the chromosomal number, as there has been of the species. It is quite possible that an even number of chromosomes, as *e. g.* twelve, may have changed into an even number (ten) without first passing through the stage of the uneven number (eleven). This might take place by the number ten appearing simultaneously in both paternal and maternal germ cells through some abnormality or deficiency in mitosis. But it is far more probable that such a mitotic abnormality would not occur coincidently in both kinds of cells—more probable, *e. g.*, that a paternal germ cell, acquiring an abnormal number of chromosomes by some fault in the process of mitosis, would conjugate with a maternal germ cell with the normal number; the result of such a union would be of course an uneven number. On this argument, when the chromosomal number changes, the period of change would be characterized by an uneven number of chromosomes. Ultimately an even number of next lower or next higher order would be reached, and that number must persist longer than the uneven number in view of the fact that uneven numbers are comparative rarities. If both paternal and maternal

germ cells gradually acquired the same uneven number of chromosomes, then by conjugation of such cells, similar numbers of chromosomes being added together, a new even number would result. But there is still another possibility by which the uneven number could pass into an even one. The odd chromosome, at least in the cases here described, does not divide in the second maturation division, and so behaves abnormally. Now such an abnormally behaving chromosome might in time become differentiated from the other chromosomes, and I venture the view that such odd chromosomes are on the way to become chromatin nucleoli. The main fact on which this conclusion is based is that in *Protenor belfragei* it is the odd, the eleventh chromosome—the "chromosome *x*"—which in the spermatocytic growth period evinces the phenomena of a chromatin nucleolus. Then another correspondence is that the chromatin nucleoli in most *Hemiptera* act like the odd true chromosome in usually not dividing in the second maturation division. Here we have an explanation for the origin of those peculiarly modified chromosomes, the chromatin nucleoli, thoroughly in accord with the facts I have described for them: the chromatin nucleoli are modified chromosomes, in point of origin the odd chromosomes which appear in the period of transition from a higher (or a lower) to a lower (or higher) even normal chromosomal number. And there are generally two chromatin nucleoli in the spermatogonia, because the odd chromosome in those cases where there is an uneven normal number had probably been formed in most cases, as it certainly appears to have originated in *Protenor belfragei*, as a union of two univalent chromosomes which had failed to separate from one another in the spirem stage of the spermatogonic mitosis. This also explains why the two chromatin nucleoli are generally placed close together in the monaster stage of the spermatogonium, they having been originally contiguous in the spirem thread.

Such an explanation of the origin of the chromatin nucleoli from the odd chromosomes seems to be in accord with all the facts, and so far may be considered a true explanation. The chromatin nucleoli are modified chromosomes, and it is the odd chromosomes which become thus modified. Conversely, we should expect that chromatin nucleoli would be formed whenever the chromosomal number in changing from a higher to a lower one, or the converse, passes through a transition period of an uneven number. Now, as has been shown in the descriptive part of this paper and tabulated on page 207, all the *Hemiptera* examined have two chromatin nucleoli, but some have a larger number. Wherever there is a larger number we find generally that they are of different volumes, and the question arises: why this difference in volume? The explanation might be that the largest ones are those most recently formed; the smallest those which had been evolved at earlier periods, and which are smaller because they are perhaps diminishing through a gradual degeneration. If the chromatin nucleoli when once formed should always preserve their

original size, there should be no gradations in volume—no degeneration on their part—so that in a given species we could determine by their number how many times the chromosomal number had changed. But when new chromatin nucleoli are formed, the older ones would seem to degenerate in the order of their formation. This assumption would explain the occurrence of very minute chromatin nucleoli found in cells of certain *Hemiptera* along with much larger ones; the minute ones would represent chromatin nucleoli formed at earlier periods, now on the way to total degeneration and disappearance. We might explain the general occurrence of one pair in the spermatogonia, or of one bivalent one in the spermatocytes, on the conclusion already reached in an earlier part of this paper, that the chromatin nucleoli are metamorphosed for a special function different from that of the other chromosomes and so necessary for the nuclear activity; and the reason for their degeneration when new ones are formed, in that a single pair would generally appear to be sufficient for this function, so that not more than one pair would remain in functional activity at one time.

Thus we find that the unexpected discovery of an uneven chromosomal number in the spermatogonia opens the way to an explanation of certain phenomena, and suggests others not anticipated. It suggests that there is a gradual evolution in the numbers of chromosomes; that they have not been fixed from the start, but that with the evolution of the species the chromosomal number changes and at each change probably passes through a period with an uneven number. In the *Hemiptera* this would seem to be, in the forms examined, a change from higher to lower numbers, and in such a change the odd chromosome becomes metamorphosed—becomes a metamorphosed chromatin nucleolus. If attention be given to these points in other groups of animals, there can be little doubt that there, too, will be found occasional examples of uneven normal chromosomal numbers, and probably also in some of these cases the production of structures comparable to the chromatin nucleoli of the Insects. There is great need, first of all, however, to determine for the *Hemiptera* whether in such cases there is a close correspondence between the spermatogonesis and ovogenesis—that correspondence I have assumed, since I have not studied the ovogenesis.

4. *Considerations on the Cycle of the Germ Cells.*

Here shall be considered in succession some points of broader interest which have arisen in the course of my studies on spermatogenesis.

(a) *The sequence of the stages of the cycle.*

In the germ cells of the *Metazoa* there may be seen regular cycles of generations following upon one another. In each cycle may be noted a stage of conjugation of ma-

ternal and paternal cells or stage of fertilization; upon this follow a number of ovogonic or spermatogonic generations, the exact number of which has not yet been determined for any metazoon; the last generation of the ovogonia or spermatogonia give rise to ovocytes or spermatocytes of the first order, and these are characterized by the synapsis stage and growth period when the reduction in the number of chromosomes is effected, the synapsis stage being evidently coincident in all forms with the commencement of the growth period; and finally occur two maturation divisions which result in the formation of ovotids or spermatids. The spermatids undergo an elaborate metamorphosis to become spermatozoa; but since such a metamorphosis is not found in the ovotids, we may disregard this stage, which evidently is far less conservative than the others; from the comparative standpoint the metamorphosis of the spermatozoon is of much less morphological significance than the preceding stages of spermatogenesis, and would appear from the recent investigations to be far more variable.

Thus each germinal cycle shows the following well-marked stages: conjugation or fertilization, a stage of a number of ovogonic or spermatogonic generations, the synapsis stage coincident with the growth period, and the stage of the two maturation divisions. Each such cycle is succeeded by a similar one, and so on indefinitely for an indefinite number of cycles. Now it is unthinkable that a cycle should be without a beginning; it must have been gradually evolved, and some particular stage in it must have been the starting point. What was this first stage? An answer is necessary before we can enter into the discussion of the meaning of the synapsis stage.

It appears to me most probable that the stage of conjugation of the germ cells must be considered the starting point. For from the studies of R. Hertwig and Maupas on Infusoria, it appears probable that conjugation or fertilization is essentially a process of rejuvenation: cells may divide and reproduce for a number of generations asexually, but there comes a period when the cellular vitality diminishes, so that no further reproduction is possible except after rejuvenation afforded by conjugation with another cell. When thus rejuvenated by admixture of substances from the other conjoint, the cell starts upon a new period of generation—the period of conjugation thus being the commencement of a cycle. As we shall see, the synapsis stage is really a delayed part of the process of conjugation, and the growth period is induced by the synapsis of the chromosomes. Having determined the starting point of the germinal cycle, we may now consider the meaning of the synapsis stage.

(b) *The phylogeny of chromosomes and the significance of the synapsis stage.*

In the considerations that follow I assume that through the germinal cycle the chromosomes preserve their individuality from generation to generation—*i. e.*, that a particular

chromosome of one generation is represented in a particular one of a preceding, so that chromosomes are not produced *de novo* in each generation. The evidence for this assumption, as regards the *Hemiptera*, has been already stated above (cf. the heading: "The process of spermatogenesis in the Hemiptera"); other evidence was shown in my study on *Peripatus* (1901), and there also the observations of other workers was considered in some detail so it is not necessary at this point to enter into these particulars. Without this assumption, which is an actuality, as I have shown in some cases, it would be very difficult to determine the meaning of the stages of the germinal cycle; while on this assumption much becomes clear, and the phenomena of the synapsis stage alone are strongly corroborative of this assumption.

Now in the cycle of the germ cells there is a chromosomal peculiarity which has been described by other investigators, but its significance has not been understood; I referred to it in my study of *Peripatus* (1901). In the anaphases of the male and female pronuclei, as in the anaphases of the early cleavage cells, it is characteristic that each chromosome becames vesicular so that at this stage each daughter nucleus appears composed of as many such vesicles as there are chromosomes. Each vesicle has its own limiting wall, and not infrequently the different vesicles may be only loosely connected together; ultimately, however, when the complete rest stage is attained, the boundaries between the vesicles disappear so that the nucleus appears a whole without separated parts.*

Rückert (1895) supposes the chromosomal vesicles to represent a shortened anaphase, occasioned by the rapid sequence of the mitoses in the blastomeres; that this is hardly a correct explanation is seen from the following considerations. From the list of cases just mentioned in the footnote it will be seen that anaphases with vesicular chromosomes are found in the pronuclei and in the earlier cleavage cells—*i. e.*, in nuclei at the beginning of the germinal cycle. I have never seen such vesicular stages in the last generations of ovogonia and spermatogonia, nor to my knowledge has any one else; but in these later

* This vesicular stage of the chromosomes in the anaphases of mitosis has been described by the following workers, though this is probably not a complete list: Remak (1855, cited by Henneguy, 1896, blastomeres of *Batrachia*); Oellacher (1872, egg of Trout); Trinchese (1875, cited by Henneguy, 1896, pole cells of Aeolididae); O. Hertwig (1876, *id. citat.*, blastomeres of *Bufo*); Fol (1879, *id. citat.*, *Toxopneustes* egg); Henneguy (1882, 1891, egg of Trout); Bellonci (1884, cited by Henneguy, 1896, blastomeres of *Axolotl*); Schwarz (1888, *id. citat.*, blastomeres of Trout); Van der Stricht (*id. citat.*, larval epidermis of *Salamandra* and *Triton*, megacaryocytes, leucoblasts and erythroblasts of embryonic liver of Mammals); Mead (1895, 1898, *Chætopterus*, female pronucleus and blastomeres up to 16-cell stage); Foot (1894, 1897, female pronucleus of *Allolobophora*); Sobotta (1897, pronuclei and first cleavage of *Amphioxus*); Kostanecki and Wierzejski (1896, male and female pronuclei of *Physa*); v. Klinckowström (1897, male and female pronuclei of *Prosthocerœus*); Rückert (1895, blastomeres of *Cyclops*); O. Schultze (1887, blastomeres of *Axolotl*); Koelliker (1889, blastomeres of *Siredon*); Van Beneden and Neyt (1887, blastomeres of *Ascaris*); Böhm (1888, male and female pronuclei and first cleavage of *Petromyzon*); Wheeler (1897, female pronucleus of *Myzostoma*, occasionally showing widely separated chromosomal vesicles); Coe (1898, female pronucleus and first cleavage of *Cerebratulus*); Boveri (1888, blastomeres of *Ascaris*).

germinal stages, as well as in apparently all adult tissue cells (compare Flemming, 1882, 1890; Zimmermann, 1890; Rabl, 1885; Torok, 1888), there is generally no such vesicular stage during the anaphase—it is then characteristic of embryonal cells, of those at the commencement of the generative cycle. An explanation of a possible reason for the chromosomal vesicles maintaining their independence was given in my paper on *Peripatus* (1901), where I referred it to the breaking of the linin spirem effected by the reduction mitosis, and maintained that no continuous chromatin spirem could be formed—*i. e.*, no close juxtaposition of the chromosomes be effected until the linin spirem had become restored.

Probably the chromosomal individuality is maintained through all the generations of the cycle, but the chromosomes seem to show their independence most markedly in the early stages, where it is strikingly evinced by their vesicular phenomena. Each vesicle appears to be potentially a little nucleus, with its ova wall, its chromatic reticulum and caryolymph, and sometimes with its own nucleoli. This is very suggestive of the possibility that each chromosome may represent, from the phyletic point of view, a nucleus; and a metazoan nucleus would then be a symbiotic union of as many nuclei as there are chromosomes. Such a conclusion might explain why the chromosomes pass through vesicular phases resembling nuclei in the earlier periods of the cycle.

So far we have seen that in the earlier portion of the germinal cycle the chromosomes remain more disconnected from one another than at later periods; in the later periods, those *e. g.* of the last generations of the spermatogonia and ovogonia, they no longer show vesicular, nuclear-like appearances in the anaphases, and appear to be more dependent upon one another—less independent. Now another line of facts may be considered in this regard. Van Beneden (1883, 1887) first showed that in the fertilized egg of *Ascaris* the paternal and maternal chromosomes remain separated from one another, so that in the prophases of the first cleavage mitosis a paternal and a maternal chromatin spirem is formed; thus Van Beneden concluded a maintenance of the individuality of the pronuclei. Then Rückert (1895) found in the cleavage cells of *Cyclops* that the paternal and maternal chromosomes form two separate groups throughout the mitosis, and that even in the rest stage there is a double nucleus, half paternal and half maternal; in the prophases there is a paternal chromatin spirem distinct from the maternal one. Up to about the 32-cell stage Rückert was able to find these double nuclei, but found that in later cleavage stages they gradually decrease in number. But Rückert is probably in error when he concludes that the separation of the paternal and maternal chromosomes is retained even up to the time of the first maturation mitosis (first pole spindle). He bases this conclusion on the discovery that in the equatorial plane of the spindle at this stage the chromosomes are arranged "ausnahmslos" into two groups. Now here the chromo-

somes are bivalent and eleven in number, so that each group cannot have the same number. Thus out of the cases examined by him, in twelve cases the chromosomes were in groups of relatively equal number (relation of six to five); in two cases, one group had four, the other group seven chromosomes; in three cases, they were arranged in groups of three and eight, respectively; and in one case, in groups of two and nine, respectively. Thus, though there may be at the period of the first maturation mitosis an arrangement of the chromosomes into two groups, yet the variable discrepancy in the number of the chromosomes composing the two groups shows that it is impossible that one group has only paternal chromosomes and the others only maternal, for the reason that at the start (in the fertilized egg) paternal and maternal chromosomes are equal in number. Accordingly, Rückert has shown for *Cyclops* that the maternal and paternal chromosomes form separate groups up to about the 32-cell stage, when the separateness of these groups gradually disappears; and his own descriptions and figures would show that at the time of the first maturation mitosis there is no longer a paternal group of chromosomes separate from a maternal group. There could also be mentioned the observations of other authors to the effect that the paternal and maternal chromosomes compose separate groups in the early cleavage cells, as especially the observations of my colleague, Prof. Conklin, on the eggs of *Crepidula.*

Accordingly, we have seen that in the earlier period of the germinal cycle, at the time of fertilization and the immediately following generations, paternal and maternal chromosomes remain separated from one another, and also that the individual chromosomes show a remarkable degree of independence as evinced by their vesicular phenomena in the anaphases. In the later stages of the germinal cycle, on the contrary, paternal and maternal chromosomes appear no longer to be arranged in separate groups, and the chromosomes themselves are no longer vesicular in the anaphases.

Now for the bearing of all this on the question of the significance of the synapsis stage. At the commencement of the germinal cycle, the stage of conjugation of the germ cells, the chromosomes are more distinct from one another than at any later stage; this distinctness gradually disappears as the cycle progresses, and at the time of the synapsis stage the chromosomes actually join together to form half the normal number of (bivalent) chromosomes. What chromosomes are these which unite to form pairs? Does a paternal chromosome unite with a paternal and a maternal with a maternal, or does a paternal chromosome unite with a maternal one? The following considerations show that the latter view is probably the true one.

First of all, in *Ascaris megalocephala univalens* there is the normal number of two chromosomes; as Brauer (1893 b) has demonstrated, one of these is paternal, the other maternal in origin; since these two unite to form one bivalent one in the synapsis stage,

this would be a union of a paternal with a maternal chromosome. Also in the *Hemiptera*, whenever there are in the spermatogonia two chromosomes which are distinguishable from the others by their greater size, as in several species described in this paper—*e. g.*, *Protenor belfragei*—these two especially large ones always unite together in the synapsis to form one bivalent one much larger than the other bivalent ones, and one of the large ones does not unite with a small one; now it can be shown that one of these large chromosomes is paternal and the other is maternal. For calling the two large chromosomes of the spermatogonia *a* and *b*, respectively, they unite in the synapsis to form the bivalent chromosome *ab*; the first maturation mitosis (here a reduction division) gives *a* to one daughter cell (second spermatocyte) and *b* to the other; the second maturation division of the one of these daughter cells gives to each spermatid $\frac{1}{2}a$, the corresponding division of the other daughter cell $\frac{1}{2}b$ to each spermatid. What we find in each of these spermatids is only *one* especially large chromosome, and not *two*. Accordingly, in order for there to be *two* in the spermatogonia, the egg cell must furnish *one*, and then that *one*, together with the *one* furnished by the spermatozoon in fertilization, would make up the *two*. Then of the two particularly large chromosomes of the spermatogonium, one would be paternal and one maternal, and since these two unite in the synapsis stage, this would be a union of a paternal chromosome with a maternal chromosome. A case where two particularly large chromosomes are distinguishable in the spermatogonia was selected for discussion, because these two, on account of their peculiarity in size, can be recognized through the maturation divisions; but if the conclusion be true that one of the large chromosomes is paternal and one maternal, and that these two join together in the synapsis, then it would be very probable that each of the other bivalent chromosomes of the spermatocytes represents a univalent paternal chromosome united with a univalent maternal one. This case, as the one of *Ascaris megalocephala univalens*, may be considered very positive cases in favor of the union of paternal with maternal chromosomes in the synapsis stage. There is still another point of view which makes this conclusion very probable. As we have seen, whenever there is an even number of chromosomes in the spermatogonia, exactly half that number of bivalent chromosomes are formed in the synapsis; thus in *Euchistus variolarius* there are fourteen univalent chromosomes in the spermatogonia, and seven bivalent ones in the first spermatocytes. Now seven of these chromosomes are paternal and seven maternal, since the spermatids have only seven. The regular formation of seven bivalent chromosomes in the synapsis stage would be only possible if maternal chromosomes united with paternal ones. For if, on the contrary, paternal chromosomes united with paternal and maternal with maternal, then of the seven paternal chromosomes three bivalent ones could be formed, but there would be left an ununited odd one, and similarly of the seven maternal chromosomes there would remain an ununited (univalent) odd one. But since

in the first spermatocytes of *Euchistus* all the chromosomes are united into pairs, so that there are no chromosomes remaining univalent, it follows that in this case it is impossible that only chromosomes of like parentage should unite together.

These considerations render it very probable that in the synapsis stage is effected a union of paternal with maternal chromosomes, so that each bivalent chromosome would consist of one univalent paternal chromosome and one univalent maternal chromosome. This conclusion allows us to consider the synapsis stage in an entirely new light, and gives an important significance to this stage. The synapsis stage then, which is characterized by the union of chromosomes into bivalent pairs, may be considered the stage of the *conjugation of the chromosomes.* When the spermatozoon conjugates with the ovum there is a mixture of cytoplasm with cytoplasm, of karyolymph with karyolymph, possibly also an intermixture of other substances; but there is then no intermixture of chromatin, for the chromosomes then, as we have seen, remain more separated from one another than at any other stage—in fact, the paternal chromosomes seem to show a repulsion for the maternal, inasmuch as they are arranged in two separate groups. But after this beginning stage of the germinal cycle, the repulsion of the paternal for the maternal chromosomes gradually diminishes, is generally no longer recognizable in the last of the spermatogonic and ovogonic divisions, and in the synapsis stage instead of a repulsion we find a positive attraction between the paternal and maternal chromosomes. The reason for the final union of these chromosomes is obvious: it is evidently to produce a rejuvenation of the chromosomes. From this standpoint the conjugation of the chromosomes in the synapsis stage may considered the final step in the process of conjugation of the germ cells. It is a process that effects the rejuvenation of the chromosomes; such rejuvenation could not be produced unless chromosomes of different parentage joined together, and there would be no apparent reason for chromosomes of like parentage to unite. At the same time the so-called "reduction in the number" of the chromosomes is effected, but this is probably not primal but rather a necessary result of the conjugation of the chromosomes. And here the point may be made that really there takes place no reduction in the number of the chromosomes in the germinal cycle, but "reduction in number" is simply a convenient phrase for expressing that in the synapsis the chromosomes unite to form pairs; no chromosomes have been lost, there is in the strict sense no reduction in number.

So we find that the synapsis stage has a very broad and important significance, of all the stages in the germinal cycle second only to the initial stage of conjugation of the germ cells. In the synapsis stage we see the final process in the conjugation of the germ cells, namely, the conjugation of the chromosomes. Now following immediately upon the synapsis stage comes the growth period of the spermatocytes and ovocytes—that period when the germ cells attain volumes greater than at any other period in the germinal cycle.

Very evidently this great increase in volume is effected by that rejuvenescence of the chromosomes secured by their conjugation. For the chromosomes are centres of metabolic activity, by conjugation of paternal with maternal chromosomes in the synapsis stage their metabolic functions are rejuvenated, and this rejuvenation finds its expression in the great changes of the growth period. So this explanation of the synapsis stage would seem to be in accord with all the facts known at present.

It is quite possible that at an earlier period in the phylogeny, the conjugation of the chromosomes may have taken place at the time of the conjugation of the germ cells, and not have been separated from that stage by a number of generations as in the modern *Metazoa*. But the determination of the original time of occurrence of the conjugation of the chromosomes is highly speculative, and so will not be entered upon here.

It is generally stated (*e.g.* Von Rath, 1893; Rückert, 1894) that the bivalent chromosomes of the spermatocytes and ovocytes of the first order are produced "by the spirem segmenting into only half the normal number of chromosomes." This is not a correct statement, since in the prophases of the first maturation mitosis there is, as I have shown in my paper on *Peripatus*, no stage of a continuous chromatin spirem. Further, this general statement is not at all explanatory of the formation of bivalent chromosomes, for it does not express any reason why the chromosomes should be joined into pairs.

It is to Moore (1895) that we owe the first clear characterization and estimation of the synapsis stage; he divided the germinal cycle into the "first period" (conjugation of germ cells, spermatogonic and ovogonic divisions), the "synaptic phases" (coincident with the growth period), and the "second period" (maturation divisions). It will be seen that my own classification of the stages is somewhat more detailed than Moore's, though it is not necessarily any better. The important characteristic of the synapsis stage is, of course, the union of chromosomes into bivalent pairs; the exact details of this process, which appear to differ in different groups, are of secondary significance.

(c) *The significance of the maturation divisions.*

The two maturation divisions of the *Metazoa* represent the terminal stages of the germinal cycle.

In the Copepods (Häcker, 1895; Rückert, 1894), the Isopods (*Oniscus*, in a just finished paper by my student, Miss Louise Nichols), in the Insects (Von Rath, 1892; Henking, 1890; Montgomery, Paulmier, 1899; McClung, 1900), and in *Peripatus* (Montgomery, 1901) there are well demonstrated cases that one of the maturation divisions is a reduction division (*pseudoreduction*, Rückert, 1894) in that it accomplishes a separation of entire univalent chromosomes from one another. Such a reduction division, a transverse splitting of the chromosomes, is not known for any other generation of the germinal cycle, nor for any somatic generation.

But in *Ascaris* (Brauer, 1893 b), in *Salamandra* (Meves, 1896), in the Rat (Lenhossek, 1898), in *Selachii* (Moore, 1895), and in *Amphiuma* (McGregor, 1899) the authorities cited agree that both maturation divisions are equational. Now it does not seem *à priori* probable that in some *Metazoa* a reduction division should occur, and in others not. The case of *Ascaris* would seem to show no sign of a reduction division, for Brauer's careful study apparently shows that each bivalent chromosome becomes split longitudinally twice; yet Sabaschnikoff's more recent study (1898) would show that another interpretation of the phenomena is possible (but not proved), namely, that the chromatin microsomes may become rearranged into fours in such a way that one of the maturation divisions may be reductional. In the Salamander, Flemming (1887) showed that the mitosis of the first generation of spermatocytes has remarkable peculiarities, so that he named it a "heterotypic" mitosis. The most remarkable of its characteristics is that the chromosomes are longitudinally split in shape like horseshoes, and that they open up into the forms of rings, the ends of the daughter horseshoes retaining their mutual connection. Such a heterotypic mitosis was corroborated by Meves in his description of the spermatogenesis of *Salamandra;* and it has been shown to be characteristic of the first maturation division in *Selachii*, the Rat, and *Amphiuma* by Moore, Lenhossek and McGregor, respectively.* All these writers show that the heterotypic mitosis results in a longitudinal division of the chromosome, and there can be no reasonable doubt of the correctness of their descriptions. But I think they are mistaken in concluding that because the heterotypic division is a longitudinal division of the chromosomes, that therefore it is an equation division. For the chromosomes of these spermatocytes are bivalent—there are just half as many in the spermatocytes as in the spermatogonia. Since there is no loss of chromosomes in the spermatocytes, there must take place a union of univalent chromosomes into pairs during some part of the growth period—*i. e.*, in the synapsis stage. I venture the view that in the Vertebrates either (1) the bivalent chromosomes are formed by every two univalent chromosomes becoming apposed to one another side to side—*i. e.*, along their whole length, so that the two would compose a double horseshoe—or (2) by the two ends of one univalent chromosome becoming closely connected with the two ends of the other, so that the whole would have the form of a ring. From what has been described for these bivalent chromosomes, we know that the longitudinal split does not divide their ends, but the ends are unsplit. Accordingly, it would appear probable that the essential process in the formation of these bivalent chromosomes is that the two ends of one univalent chromosome become united with the two ends of another, while it would be of secondary importance whether the two chromosomes might be apposed along their whole lengths or not.

*Moore states that the second maturation division is also heterotypic, but his figures do not prove his point, which needs reëxamination

But from this it would follow that the heterotypic mitosis of the first spermatocytes of the Vertebrates is really a reduction division, and results in the separation of whole univalent chromosomes. Then the longitudinal split of such bivalent chromosomes would be really the space between two univalent chromosomes. Thus, though these chromosomes may appear in the prophases longitudinally split, yet a separation of the daughter chromosomes along the line of this split would not be an equational division. The workers on vertebrate spermatogenesis have indeed shown that the bivalent chromosomes are split longitudinally, but since none of them have succeeded in demonstrating how the bivalent chromosomes are formed in the synapsis stage they could not show the significance of this longitudinal split. For *Peripatus* and the *Hemiptera* I have shown that a bivalent chromosome is produced by one end of one univalent chromosome uniting with one end of another; while in the *Vertebrata*, if my interpretation is correct, a bivalent chromosome would be produced by the union of both ends of one univalent chromosome with both ends of another—the spermatogonic chromosome is U-shaped, the spermatocytic chromosome is ring-shaped since it represents two such U-shaped elements with their ends connected. Also in *Peripatus* and the *Hemiptera* there are occasionally ring-shaped chromosomes similar to the heterotypic chromosomes of Vertebrates, and they are formed by the two ends of one univalent chromosome being joined with the two ends of another, instead of one end being joined simply with one end.

This interpretation explains, and the process has never been satisfactorily explained before, why one of the maturation mitoses in Vertebrates is heterotypic: it is a reduction division separating entire univalent chromosomes, and it differs from all other mitoses of the germinal cycle because it is the only one of them which does separate entire chromosomes. If this view is true, then probably all *Metazoa* would have in common the occurrence of one reduction division, and we should no longer be confronted by the discrepancy between *Metazoa* with and those without a reduction division. The occurrence of a reduction division is actually proved for the *Copepoda*, *Insecta*, *Oniscus* and *Peripatus* (I shall not mention other objects where it has been rendered probable but not thoroughly proven); *à priori* we should expect that one would occur in the Vertebrates also, and in the Vertebrates there does occur a peculiar heterotypic division which, as we have seen, can be satisfactorily explained as a reduction division. Accordingly, the term "heterotypic mitosis" might be applied to any mitosis which results in the separation of whole univalent chromosomes, irrespective whether it divides the bivalent chromosome transversely or longitudinally; the term "heterotypic" is indeed most excellent in that it expresses a mitosis "of a type of a different kind," one differing from all other mitoses of the germinal cycle. Of very secondary importance, then, would be the form of the chromosomes—not the form but the way in which the chromosomes divide should be

taken as the criterion of the heterotypic mitosis. This signification would be different from that originally defined by Flemming (1887), but it would certainly be a step toward greater clearness to use "heterotypic" division in the place of the promiscuously used "reduction" division.

Now that we have seen that a reduction division occurs in the *Copepoda, Insecta, Oniscus* and *Peripatus*, and that the heterotypic division of the *Vertebrata* may be interpreted as a reduction division also, we have to try to explain why such a reduction division occurs. In the synapsis stage there is a conjugation of paternal with maternal chromosomes for the purpose of rejuvenation of the chromosomes as metabolic centres, and this rejuvenation is exemplified in the great metabolic activity of the growth period. Now, R. Hertwig and Maupas have shown for the *Infusoria* that the two conjoints remain for only a certain period in apposition, and that when the interchange of nuclei necessary for rejuvenation has been accomplished the conjoints separate. Of course it is not a true analogy to compare conjugating *Infusoria* (*i. e.*, whole cells) with conjugating chromosomes (*i. e.*, portions of cells). But still it is very probable that two chromosomes unite temporarily for the same reason that two *Infusoria* do, that is, for an interchange of substances; and when the chromosomes have accomplished this interchange there would no longer be any necessity for continued apposition, so they tend to separate from one another. It is the reduction division in *Metazoa* which accomplishes the complete separation, though it may commence in the prophases of this division. It is conceivable that the conjugated chromosomes might separate as they had come together, without the intervention of a mitosis. But in the *Metazoa*, so far as we know, they become separated only by the agency of a mitosis, and that is the reduction mitosis. At the beginning of the germinal cycle there is a repulsion of paternal and maternal chromosomes for one another, during the synapsis a strong attraction, and at the end of the germinal cycle a repulsion again, but not a repulsion so strong as to distribute the chromosomes into two groups in the spermatid and ovotid. Only by a reduction division can paternal and maternal chromosomes become wholly separated, for only then do the interchromosomal linin fibres (persisting portions of the linin spirem : compare my paper on *Peripatus*) become broken.

The question is complicated because another maturation division occurs, an equational division: in the *Insecta, Oniscus, Peripatus* and the Vertebrates the reduction division precedes the equational, in the *Copepoda* (according to Rückert, 1894) the reverse is the case. It is not difficult to explain why an equation division should occur at this time, for the cell has increased in volume very greatly during the growth period, and great increase in volume (increase beyond the individual mass) would appear to be a main factor in inducing cell division. With this increase in volume of the cell the chromosomes also increase in volume (though by no means in a direct ratio), and each univalent

component of a bivalent chromosome divides into two longitudinally (equationally), this being the usual mode of division of a chromosome—in fact the only known method of reproduction of univalent chromosomes. From this standpoint the growth period would be the inducer of the equational maturation mitosis, and this mitosis would be strictly comparable physiologically to any other equation mitosis of the germinal cycle. But at the time that the cell is preparing for this equation division, paternal and maternal chromosomes, having accomplished the purpose which occasioned their conjugation, show a tendency to repulsion for each other, and so evince the need of becoming disconnected. The cell already started into mitotic activity would offer mechanical possibilities to effect the separation of the maternal from the paternal chromosomes, so that instead of a single mitotic process there are two in rapid succession, sometimes with not a trace of a rest stage in between, one separating entire univalent chromosomes, the other separating the halves of each univalent chromosome. It would be very enticing to enter here into the mechanics of this mitosis, which would be practically a determination of the points of apposition of the mantle fibres on the chromosomes; but such an inquiry is hardly germane to the present discussion. The point to be made is that in the *Metazoa* there follows after the growth period an equation mitosis, because in the growth period the cell has increased beyond the normal size; and that a reduction division occurs about the same time in order to affect a complete separation from one another of the paternal and maternal chromosomes, which, having accomplished the purpose for which they conjugated, show again a repulsion for each other. The growth period is the inducer of the equation division, the mutual repulsion of chromosomes of different parentage the inducer of the reduction division. The chromosomes in the late anaphases, after the maturation divisions, become vesicular and so show a great degree of mutual independence, because the reduction division had severed their linin connections.

In conclusion, it would be very interesting to enter into the question of the parallelism of the germinal cycle in *Metazoa* and *Protozoa*, as has been done by Henking and Moore (1895). However, it would be well first to have ascertained the significance in the cycle of the *Metazoa*, as far as that can be done without reference to the states in the *Protozoa*. The chromosomes are the cell components on which the problem can be best studied.

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Explanation of the Plates.

All figures have been drawn with the camera lucida at the level of the base of the microscope, with the homogeneous immersion objective $\frac{1}{12}$ of Zeiss and ocular 4, tube length 180 mm. In the majority only the chromatin nucleoli, chromosomes and true nucleoli together with the outline of the nucleus or cell body has been drawn ; and in the majority of figures representing lateral views of monaster stages, the mantle fibres, connective fibres, and centrosomes are the only structures shown beside the chromatin elements. For *Euchistus variolarius*, however, the various structures are represented in detail, and this is also the case with some of the figures of various other species.

The following abbreviations have been employed (for others not here mentioned the descriptive text must be referred to):

C. Mb., cell membrane.
N., true nucleolus (plasmosome).
N. 2, chromatin nucleolus (modified chromosome).
N. Mb., nuclear membrane.

Plate 1.

Euchistus variolarius, Figs. 1–19

Fig. 1. Nucleus of spermatogonium, rest stage.
Figs. 2, 3. Pole views of spermatogonic monasters.

Figs. 4, 5. Lateral views of synapsis stages, only a few of the chromatin elements shown.
Fig. 6. Nucleus, synapsis, showing two whole bivalent chromosomes.
Fig. 7. One whole bivalent chromosome, end of the synapsis stage.
Figs. 8, 9. Postsynapsis stages, in each three whole bivalent chromosomes shown.
Fig. 10. Telophase of the spermatocyte, showing two whole bivalent chromosomes.
Fig. 11. Late telophase, showing eight bivalent chromosomes.
Fig. 12. Rest stage of spermatocyte.
Figs. 13, 14. Early prophases of first maturation division, each figure showing two whole bivalent chromosomes.
Fig. 15. Two whole bivalent chromosomes, a little later stage than the preceding, showing their linin connections.
Figs. 16, 17. Later prophases, only in Fig. 16 are all bivalent chromatin elements shown; in Fig. 17 the centrosome pairs on the surface of the nucleus.
Fig. 18. Lateral view of the monaster of the first maturation mitosis, all chromatin elements shown.
Fig. 19. Pole view of the same stage.

Euchistus tristigmus, Figs. 20–26.

Fig. 20. Pole view of spermatogonic monaster.
Figs. 21, 22. Nuclei of first spermatocytes, rest stage.
Figs. 23, 24. Pole views of monaster, first maturation division.
Fig. 25. Lateral view of spindle, first maturation division (showing all chromatin elements).
Fig. 26. Second spermatocyte, chromatin elements not definitely arranged in the equator of the spindle

Podisus spinosus, Figs. 27–29.

Fig. 27. Pole view of spermatogonic monaster.
Fig. 28. Telophase of first spermatocyte, nucleus.
Fig. 29. Pole view of monaster, first maturation mitosis.

Mormidea lugens, Figs. 30–33.

Fig. 30. Nucleus of spermatogonium, commencement of prophase.
Fig. 31. Pole view of spermatogonic monaster.
Fig. 32. Nucleus, postsynapsis stage.
Fig. 33. Pole view of monaster, first maturation mitosis.

Peribalus limbolaris, Figs. 34–37.

Fig. 34. Spermatogonic nucleus, rest stage.
Fig. 35. Pole view of spermatogonic monaster.
Fig. 36. Nucleus of first spermatocyte, rest stage.
Fig. 37. Pole view of monaster, first maturation mitosis.

Cosmopepla carnifex, Figs. 38–41.

Fig. 38. Pole view of spermatogonic monaster.
Fig. 39. Nucleus of first spermatocyte, rest stage.
Fig. 40. Lateral view of the spindle, first maturation mitosis, showing all chromatin elements.
Fig. 41. Pole view of the same stage.

Nezara hilaris, Figs. 42–45.

Figs. 42, 43. Spermatogonic nuclei, commencement of prophase.
Fig. 44. Pole view of spermatogonic monaster.
Fig. 45. Nucleus of first spermatocyte, early telaphase.

Brochymena sp., Figs. 46–49.

Fig. 46. Spermatogonic nucleus, rest stage.
Fig. 47. Pole view of spermatogonic monaster.

Plate II.

Brochymena sp., Figs. 48, 49.

Fig. 48. Nucleus of first spermatocyte, telaphase.
Fig. 49. Pole view of monaster, first maturation mitosis.

Perillus confluens, Figs. 50–53.

Fig. 50. Spermatogonic nucleus, rest stage.
Fig. 51. Spermatogonic monaster, pole view.
Fig. 52. Nucleus of first spermatocyte, rest stage.
Fig. 53. Pole view of monaster, first maturation mitosis.

Cosmus delius, Figs. 54–63.

Fig. 54 Spermatogonic nucleus, rest stage.
Fig. 55. Spermatogonic monaster, pole view.
Figs. 57, 58. Nuclei of first spermatocytes, rest stage.
Figs. 59, 60. Pole views of monasters, first maturation mitosis.
Fig. 61. Lateral view of the same stage, showing all the chromatin elements.
Fig. 62. Pole view of monaster, first maturation mitosis.
Fig. 63. Nucleus of first spermatocyte, rest stage.

Trichopepla semivittata, Figs. 64–69.

Fig. 64. Spermatogonic nucleus, rest stage.
Fig. 65. Spermatogonic monaster, pole view.
Fig. 66. Nucleus of first spermatocyte, synapsis.
Fig. 67. Nucleus of first spermatocyte, rest stage.
Fig. 68. Pole view of monaster, first maturation mitosis.
Fig. 69. Lateral view of slightly earlier stage, showing all the chromatin elements.

Euryguster alternatus, Figs. 70, 71.

Fig. 70. Nucleus of first spermatocyte, rest stage.
Fig. 71. Pole view of monaster, first maturation mitosis.

Anasa tristis, Figs. 72–76.

Figs. 72, 73. Spermatogonic nuclei, rest stage.
Fig. 74. Spermatogonic monaster, pole view.
Fig. 75. Nucleus of first spermatocyte, telaphase
Fig. 76. Pole view of monaster, first maturation mitosis.

Anasa armigera, Figs. 77, 78.

Fig. 77. Spermatogonic monaster, pole view.
Fig. 78. Pole view of the spindle of the first maturation division, the chromatin elements not yet definitely arranged in the plane of the equator.

Anasa sp., Figs. 79–83.

Fig. 79. Spermatogonic nucleus, rest stage.
Fig. 80. Spermatogonic monaster, pole view.
Fig. 81. Nucleus of first spermatocyte, rest stage.
Fig. 82. Pole view of monaster, first maturation division.
Fig. 83. Lateral view of four bivalent chromosomes, monaster stage of first maturation mitosis, the poles of the spindle outside of the plane of the section.

Metapodius terminalis, Figs. 84–87.

Fig. 84. Spermatogonic nucleus, rest stage.
Fig. 85. Spermatogonic monaster, pole view.
Fig. 86. Nucleus of first spermatocyte, telaphase.
Fig. 87. Pole view of monaster, first maturation mitosis.

Chariesterus antennator, Figs. 88–90.

Fig. 88. Nucleus of first spermatocyte, telaphase.
Fig. 89. Lateral view of monaster stage of the first maturation mitosis, showing all the chromatin elements.
Fig. 90. Pole view of the same stage.

Alydus pilosulus, Figs. 91–95.

Fig. 91. Spermatogonic nucleus, rest stage.
Fig. 92. Spermatogonic monaster, pole view.
Figs. 93, 94. Nuclei of first spermatocytes, rest stage.
Fig. 95. Pole view of monaster, first maturation mitosis.

Plate III.

Alydus eurinus, Figs. 96–102.

Fig. 96. Spermatogonic monaster, pole view.
Fig. 97. Nucleus of first spermatocyte, telaphase.
Fig. 98. Pole view of monaster, first maturation mitosis.
Fig. 99. Lateral view of the same stage.
Fig. 100. Pole view of monaster, second maturation mitosis.
Figs. 101, 102. Spermatids at close of second maturation mitosis.

Corizus lateralis, Figs. 103–106.

Fig. 103. Nucleus of first spermatocyte, telaphase.
Figs. 104, 105. Pole views of monasters, first maturation mitosis.
Fig. 106. Oblique view of the spindle of the first maturation mitosis, before the chromosomes have taken their definite position in the equator.

Harmostes reflexulus, Figs. 107–117.

Fig. 107. Spermatogonic nucleus, rest stage.
Figs. 108–110. Spermatogonic monasters, pole views.
Fig. 111. Nucleus of first spermatocyte, rest stage.
Fig. 112. Pole view of monaster, first maturation mitosis.
Fig. 113. Lateral view of the same stage, showing all the chromatin elements.

Figs. 114, 115. Pole views of monasters, first maturation mitosis.
Fig. 116. Lateral view of the same stage, showing all the chromatin elements.
Fig. 117. Pole view of spermatid at the close of the second maturation division.

Protenor belfragei, Figs. 118–141.

Fig. 118. Spermatogonic nucleus, early prophase.
Figs. 119–123. Spermatogonic monasters, pole views.
Fig. 124. Nucleus of first spermatocyte, synapsis.
Figs. 125–128. Lateral views of the large chromosome *x*, from nuclei in the late synapsis stage.
Figs. 129, 130. Nuclei of first spermatocytes, telaphase.
Figs. 131–134. Nuclei of first spermatocytes in successive prophases.
Figs. 135, 136. Lateral views of successive monaster stages, first maturation mitosis, all the chromatin elements shown in Fig. 135.
Fig. 137. Pole view of the stage of Fig. 136.
Fig. 138. Lateral view of the anaphase, first maturation mitosis.
Fig. 139. Pole view of second spermatocyte, chromosomes not definitely arranged in the equator of the spindle.
Fig. 140. Lateral view of anaphase, second maturation mitosis.
Fig. 141. Still later anaphase.

Plate IV.

Cymus angustatus, Figs. 142-144.

Fig. 142. Lateral view of monaster, first maturation mitosis.
Fig. 143. Pole view of one daughter cell (second spermatocyte) of the dyaster stage of the first maturation mitosis, the univalent chromatin elements seen laterally.
Fig. 144. Pole view of one chromosome plate, metakinesis of first maturation mitosis, chromatin elements seen on end view, except the one marked *a*.

Ichnodemus falicus, Figs. 145–148.

Fig. 145. Spermatogonic monaster, pole view.
Fig. 146. Nucleus of first spermatocyte, late prophase, showing all the chromatin elements.
Figs 147, 148. Pole views of monasters, first maturation mitosis, in Fig. 148 two of the chromosomes viewed laterally.

Peliopelta abbreviata, Figs. 149–151.

Fig. 149. Spermatogonic monaster, pole view.
Fig. 150. Pole view of monaster, first maturation mitosis.
Fig. 151. Lateral view of same stage, two of the large chromosomes not shown.

Oecanthus dorsalis, Figs. 152–158.

Fig. 152. Spermatogonic nucleus, rest stage.
Figs. 153, 154. Spermatogonic monasters, pole views.
Fig. 155. Nucleus of first spermatocyte, rest stage.
Fig. 156. Pole view of monaster, first maturation mitosis.
Fig. 157. Lateral view of the same stage, three of the chromosomes not shown.
Fig. 158. Lateral view of the anaphase, first maturation mitosis

Oncopeltus fasciatus, Figs. 159–171.

Fig. 159. Spermatogonic nucleus, early prophase.
Fig. 160. Spermatogonic monaster, pole view.

Figs. 161–165. Nuclei of first spermatocytes, rest stage.

Fig. 166. Nucleus of first spermatocyte, late prophase, showing all the chromatin elements.

Figs. 167, 168. Pole views of monasters, first maturation mitosis.

Fig. 169. Lateral view of same stage, five of the chromosomes not shown.

Fig. 170. Lateral view of anaphase, first maturation mitosis.

Fig. 171. Pole view of second spermatocyte, chromatin elements not definitely arranged in the equator of the spindle.

Leptopterna dolabrata, Figs. 172–176.

Figs. 172–175. Nuclei of first spermatocytes, growth period.

Fig. 176. Pole view of monaster, second (?) maturation mitosis.

Calocoris rapidus, Figs. 177–188.

Fig. 177. Spermatogonic monaster, pole view.

Figs. 178–180. Nuclei of first spermatocytes, telaphase.

Fig. 181. Oblique lateral view of the spindle before the chromosomes are arranged in the plane of the equator, first maturation mitosis.

Figs. 182–184. Oblique lateral views of monasters, first maturation mitosis.

Figs. 185, 186. Pole views of the same stage.

Figs. 187, 188. Pole views of monasters, second maturation mitosis.

Pœcilocapsus lineatus, Figs. 189, 190.

Fig. 189. Nucleus of first spermatocyte, early telaphase.

Fig. 190. Pole view of monaster, first maturation mitosis.

Plate V.

Pœcilocapsus goniphorus, Figs. 191–198.

Figs. 191–195. Nuclei of first spermatocytes, rest stage.

Figs. 196, 197. Pole views of monasters, first maturation mitosis.

Fig. 198. Lateral view of the same stage.

Phymata sp., Figs. 199–203.

Fig. 199. Spermatogonic nucleus, rest stage.

Fig. 200. Spermatogonic monaster, pole view.

Fig. 201. Nucleus of first spermatocyte, telaphase.

Fig. 202. Pole view of monaster, first maturation mitosis.

Fig. 203. Lateral view of same stage.

Coriscus ferus, Figs. 204–206.

Figs. 204, 205. Nuclei of first spermatocytes, telaphase and rest stages respectively.

Fig. 206. Pole view of first spermatocyte, the chromosomes not definitely arranged in the plane of the equator of the spindle.

Acholla multispinosa, Figs. 207–211.

Fig. 207. Spermatogonic monaster, pole view.

Figs. 208, 209. Nuclei of first spermatocytes, early prophase.

Fig. 210. Pole view of monaster, first maturation mitosis.

Fig. 211. Pole view of monaster, second maturation mitosis.

Sinea diadema, Figs. 212–218.

Figs. 212, 213. Nuclei of first spermatocytes, telaphase.
Figs. 214, 215. Pole views of monasters, first maturation mitosis.
Fig. 216. Lateral view of the plurivalent chromosome of the first maturation mitosis, showing the mantle fibre attachments.
Figs. 217, 218. Lateral views of successive anaphases, first maturation mitosis.

Limnobates lineata.

Fig. 219. Nucleus of first spermatocyte, rest stage.

Prionidus cristatus, Figs. 220–225.

Figs. 220–222. Spermatogonic nuclei, rest stage.
Figs. 223, 224. Spermatogonic monasters, pole views.
Fig. 225. Nucleus of first spermatocyte, rest stage.

Milyas cinctus, Figs. 226–228.

Figs. 226–228. Nuclei of first spermatocytes, rest stage.

Hygotrechus sp., Figs. 229–231.

Fig. 229. Spermatogonic monaster, pole view.
Fig. 230. Nucleus of first spermatocyte, synapsis stage.
Fig. 231. Pole view of monaster, first maturation mitosis.

Limnotrechus marginatus, Figs. 232, 233.

Fig. 232. Nucleus of first spermatocyte, rest stage.
Fig. 233. Pole view of monaster, first maturation mitosis.

Pelocoris femorata.

Fig. 234. Spermatogonic monaster, pole view.

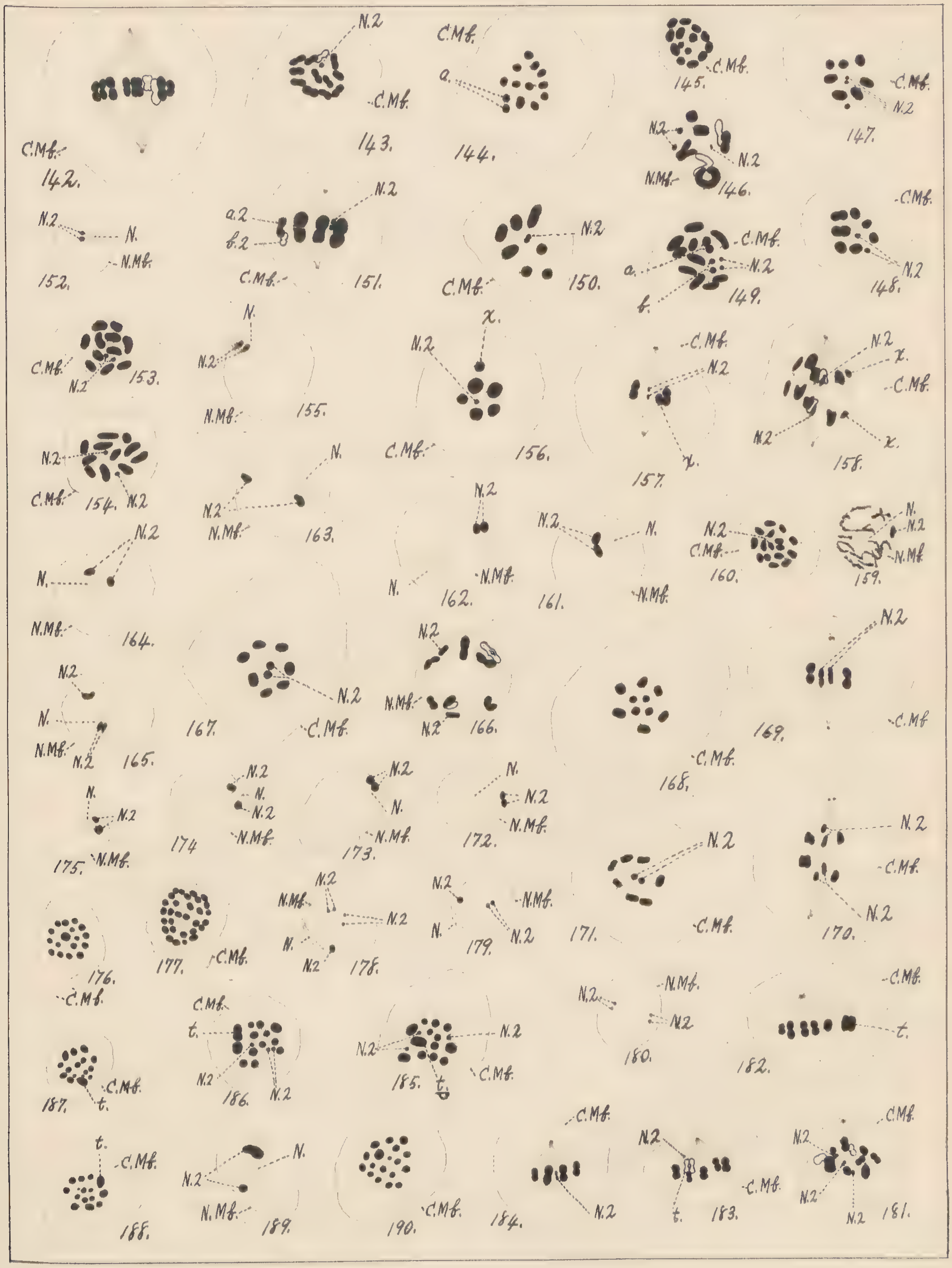
Zaitha sp., Figs. 235–238.

Fig. 235. Spermatogonic nucleus, rest stage.
Figs. 236, 237. Spermatogonic monasters, pole views.
Fig. 238. Pole view of monaster, first maturation mitosis.

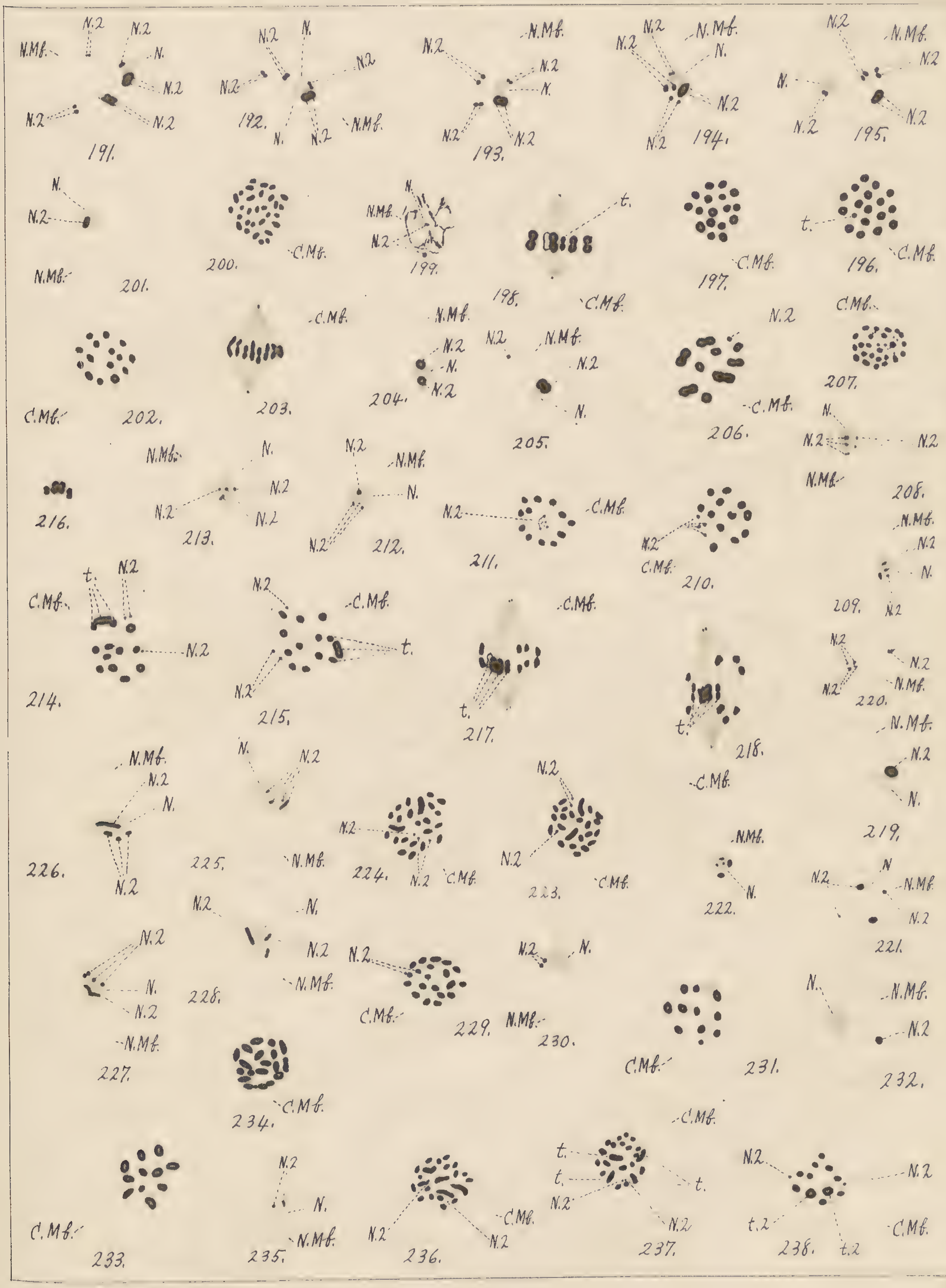
Montgomery, Del. Plate I.

Montgomery, Del. Plate 2.

Montgomery, Del. Plate 3.



Montgomery, Del. Plate 4.



Montgomery, Del. Plate 5.

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VOLUME XX.—NEW SERIES.

PART III.

ARTICLE V.—*Fossil Mammalia of the White River Beds of Montana. By Earl Douglass.*

ARTICLE VI.—*Results of Observation with the Zenith Telescope of the Sayre Observatory from April 1, 1876, to December 27, 1893. By Charles L. Doolittle.*

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1902.

ARTICLE V.

FOSSIL MAMMALIA OF THE WHITE RIVER BEDS OF MONTANA.

BY EARL DOUGLASS.

(Read May 3, 1901.)

Since writing my paper on the Tertiary deposits of western Montana (1899)* further explorations have been made and many valuable fossils secured. Part of these fossils have been studied under more favorable circumstances, so that interesting additions can now be made to our knowledge of these beds.

In June, 1899, Prof. F. D. Smith, of the University of Montana, and myself started eastward from Missoula with team and camping outfit, he to collect geological specimens for the University and I to make further explorations in the Tertiary deposits, and to add, if possible, to my collection of fossil mammals. Nearly all of my previous collecting had been done east of the main divide or watershed of the Rocky Mountains. I had found that Tertiary deposits occurred in the valleys of Flint and Deer Lodge creeks, and it was hoped that enough fossils might be obtained to determine the horizons of these beds and their relation to those east of the divide.

In the valley of Flint creek, south of Drummond, near the village of New Chicago, the upper deposits were found to contain, in a limited area, quite an abundance of valuable Loup Fork fossils. The exact relation of these beds to those of other localities is still a matter of doubt. The strata and the occurrence of the fossils are almost exactly as in the upper Deep River beds. This is not true of any other deposits I have seen. The bones, as a rule, are in nodules in cream-colored clays. The species seem to be mostly new, but have not been thoroughly studied. Some of the most interesting specimens are a strange animal which had a proboscis and was related to *Merycochœrus*, a hog-like animal, the first found in America, and a skull of the so-called *Blastomeryx*, of the *B. borealis* type, with a mandible, proving that it is *Palœomeryx*. Nearly all parts of the skeleton of *Palœomeryx* were found. The *Merycochœrus*-like animal I have described

* See list of works on page 279.

under the name of *Merycochœrus laticeps* (1900); but since seeing the skulls of this genus in the American Museum of Natural History, I am inclined to think it will have to be given a new generic name. Both of these are vastly different from the John Day forms, *Promerycochœrus*, that have been put in this genus.

The beds underlying these look like some of the Oligocene east of the main divide. They are light colored. There are layers of limestone containing fresh-water snails. In one place there were thinly laminated shales with a few fish remains.

A few miles to the northeast, on the north side of the Hell Gate river, in gray sandy bluffs, the skulls of a dog much like *Temnocyon*, a *Leptomeryx*, and an Oreodont were discovered. These beds may be John Day.

Before going to a new field Prof. Smith was called away and Mr. Homer McDonald, a student of the University, accompanied me during the remainder of the time. After obtaining a few remains of a large rhinoceros, a large camel, and some poorly preserved mastodon teeth from the later Tertiary in the Deer Lodge valley, we crossed the divide southwest of Butte.

Near Whitehall, at two localities on Pipestone creek, one near Pipestone Springs and one on a branch called the Little Pipestone, were limited exposures where many small bones, teeth, and fragments of jaws were found. These were associated with distinguishable *Titanotherium* remains which were not of the largest species.

After making a valuable collection here we moved eastward, examining the Tertiary deposits on the North Boulder and obtaining jaws and teeth of a *Protohippus*.

Northwest of Three Forks are gray beds composed of fine material containing lime and looking much like the beds on Pipestone creek. There are also layers of hard limestone which break into angular fragments. Here there were a good many *Titanotherium* remains. We obtained large parts of two skeletons and other bones. Some interesting little Oreodonts, including a little *Agriochœrus*, were obtained, descriptions of which will be found in this paper.

Last spring (June, 1900) I again started from Missoula, going up the Big Blackfoot river, hoping to find Tertiary deposits on this river or on Nevada creek, one of its principal branches. The country around Ovando is covered with glacial drift, but on the road from that place to Helmville, near where it crosses the Big Blackfoot, the drift becomes thin and finally vanishes. The river cuts into the Tertiary deposits, in some places making quite high bluffs. I found no fossils here except wood fragments, but the beds are undoubtedly Oligocene (White River or John Day). After passing through a quite long cañon in going southeast up Nevada creek, the Tertiary appears again. The rock is mostly soft, but in places thousands of flint fragments have weathered out and are scattered over the surface. In some of these there are fossil snails. A few miles north of

Avon some bone fragments were found, which confirmed the belief that these beds are Oligocene.

After crossing a basaltic lava flow south of Avon the Tertiary beds appear again, but the fossils obtained here, as previously stated, are of later date, being either Miocene or Pliocene. Continuing my course southward I found that south of Silver Bow, as had been mistrusted, the lake bed deposits were continuous across the main divide. It is evident that previous to Miocene times a river had carved out a broad valley across what is now the watershed that divides the waters of the Atlantic from those of the Pacific; so the divide then occupied a different position from what it does now. In Tertiary times, probably by the formation of a great lake, this valley was partly filled with sediment, and after the drying up of the lake the drainage was changed. It is very probable that at some time during the Tertiary a lake extended from the northern part of the Deer Lodge valley southward to the Big Hole, eastward to the Jefferson, then northeastward to the Missouri river and down the Missouri to the region of Helena, a distance of 180 miles. There is no barrier and it is evident that there was none, and the Tertiary deposits can be traced the greater portion of the way. This, of course, may have happened more than once. A little south of the divide, on Divide creek, part of the skull and skeleton of a small horse was obtained.

There are only three regions from which fossils have been secured sufficiently abundant and characteristic, so that it can be positively stated now that the strata are White River; but there are other regions that are only a little doubtful. I believe that the White River, like the Loup Fork, occurs in all the principal valleys of southwestern Montana.

There is some doubt concerning the John Day. The lower Deep River beds near White Sulphur Springs appear to belong to that age (Scott, 1893), and some fossils in my collection, especially those obtained east of Drummond, appear to be more like John Day than White River, but there are not enough to settle the question.

The three regions that are certainly White River are: (1) on Pipestone creek, (2) on Thompson creek northwest of Three Forks, and (3) northeast of Toston near Cottonwood creek. Those on Blacktail Deer creek are probably White River. For convenience, until the strata in the different localities are satisfactorily correlated, I will give them local names.

White River Oligocene.

Pipestone Beds.

These are on Pipestone creek at two localities, one on the Big Pipestone near Pipestone Springs and the other on a branch, the Little Pipestone. The first is north of west and

Explanation of Map.

The map shows only approximately the Tertiary areas, as their limits have not been mapped or accurately defined. I have personally observed the Tertiary deposits in all the regions in which they are indicated, except in the small areas in the Yellowstone valley.

Where there is doubt as to the subdivisions the general term Tertiary has been used. By Oligocene, White River or John Day is meant. In the small spot marked Eocene (?), near Lima, fossils were found, but they appear so contradictory that it was thought best not to publish descriptions of the fossils until the beds were reëxamined and a solution of the problem found.

Places marked W ? L? etc., indicate that the beds are doubtfully White River, Loup Fork, etc.

MAP of SOUTHWESTERN MONTANA

the second south of west of Whitehall, in Jefferson county. The strata containing the bones are a sandy clay that swells and cracks on weathering and crackles under the feet when dry, and a light-gray fine-grained homogeneous material. Under the microscope the latter shows many angular, glassy fragments, which are undoubtedly volcanic dust. The fossils have not all been determined. Most of them are new. The following is a partial list:

Ictops acutidens, sp. nov.
Eumys minor, sp. nov.
Cylindrodon fontis, gen. et sp. nov.
Sciurus jeffersoni, sp. nov.
Ischyromis typus Leidy.
Palæolagus temnodon, sp. nov.
Palæolagus triplex (?) Cope.
Palæolagus turgidus (?) Cope.
Hyænodon minutus, sp. nov.
Agriochœrus maximus, sp. nov.
Mesohippus bairdi (?).
Leptochœrus.
Leptomeryx.
Hyracodon.

Thompson Creek Beds.

These are well exposed on a creek draining a small region northwest of Three Forks. The stream is small and nearly dry in summer, and I do not know that it is named on any map, but I have called it Thompson creek from the only man who lives near it. If they were called Three Forks beds they would be confused with the Three Forks formation which is Devonian. In these beds are the cracking clays above mentioned as occurring on Pipestone creek, also light colored material resembling that occurring at that place but containing lime. There are layers of limestone and strata of hard sandstone.

Most of the fossils were found on the north branch of Thompson creek near the road to Boulder. Farther to the southwest are large quantities of fossil wood, but only occasional bone fragments. The most abundant vertebrate remains are bones of Titanotheres. These have not been studied, but they do not belong to the largest species.

List of Fossils.

Limnenetes platyceps, gen. et sp. nov.
Limnenetes (?) *anceps*, sp. nov.
Agriochœrus minimus, sp. nov.
Mesohippus.
Colodon.
Titanotherium.

Toston Beds.

These are exposed northeast of Toston, which is a small railroad station on the Missouri river below Three Forks and above Townsend. They are about twenty-five miles north and east of the Thompson Creek beds. While the last named deposits apparently belong to the lower White River or Titanotherium horizon, part, at least, of these seem to

more nearly correspond to the Oreodon division. Among the fossils are three very good skulls of Oreodonts. One I have referred to the genus *Eucrotaphus*, one is a new species of Oreodon and one is much like *O. culbertsoni*. A good portion of the skeleton of the latter was found, but there has not been time to clean it and make careful comparisons. It is probable that it will have to be referred to a new species.

These and other Oreodont remains were in the cracking, sandy clays which contain nodular layers. A *Titanotherium* tooth was found in the same kind of clay but perhaps a trifle lower down. *Colodon* and *Hyœnodon* teeth and jaws were obtained, but I cannot state with certainty their relation to the beds above mentioned. The strata here are considerably disturbed, and in some places dip to the eastward as much as 30° to 40°. In the ardent work of collecting I had not the time to study the geology of the region as much as I hope to do later. Lying unconformably on these deposits in places are nearly horizontal strata of later date, either Miocene or Pliocene.

List of Fossils.

Hyœnodon montanus, sp. nov.
Oreodon robustum, sp. nov.
Eucrotaphus helenæ, sp. nov.
Colodon cingulatus, sp. nov.
Colodon, sp.
Mesohippus.
Titanotherium.
Cœnopus (?).

The Blacktail Deer Creek Beds.

These are on Blacktail Deer creek, about thirty miles south and east of Dillon. The exposure is small and only a few fossils were found. The material, as in the localities previously mentioned, is mostly light colored and fine grained, yet there are thin strata of sandstone. None of the fossils positively determine the horizon. There was the new genus *Arretotherium*, part of the back of a skull of *Cœnopus* about the size of *Aceratherium tridactylum* Osborn, and part of a mandible of *Steneofiber hesperus* sp. nov. which is described in this paper.

List of Fossils.

Steneofiber hesperus, sp. nov.
Cœnopus (?).
Arretotherium acridens, gen. et sp. nov.

The skull of *Steneofiber complexus*, described in this paper, came from the beds on the west side of the Madison river above Three Forks (Douglass, 1899, p. 4). The locality is about fifteen miles south of where the fossils occur in the Thompson Creek beds. Near the same place were a femur, tibia, fibula and calcaneum of a rather long-limbed Perissodactyl, probably a rhinoceros, but the deposits here contain very few fossils.

There are turtle remains in all the beds above described.

Besides the above there are at least three localities where fragments of fossils that are almost certainly White River have been collected. They are north of Avon in Deer Lodge county, at Glendale in Beaverhead county, and west of Puller Springs near the Ruby river in Madison county.

In Montana vertebrate fossils of the Tertiary have not been found in anything like abundance except at two or three restricted localities, and these long distances apart, though a few have been found in as many as twenty different places. In the White River they were the most numerous on Pipestone creek, but they are mostly isolated teeth, jaws and other bones of small animals. Certain strata are quite rich in fossils, but on account of their dip and their being, as a rule, covered with vegetation or débris, they are exposed for only short distances. It is curious, though, that in all the beds in which collecting has been done surprisingly few duplicates have been obtained, and few of the things have been found anywhere else. The White River collection, as it has been studied and compared with those of other regions, has caused continual surprise on account of its great difference from them. The explanation seems to lie partly in the fact that in Montana we have quite a rich fauna from a horizon nearly or quite corresponding to the lower White River or Titanotherium beds of South Dakota, where few fossils except Titanotheres have been found. Though the fossils were scattered over a large area (about 150 by 170 miles) and were not especially abundant, yet during the six years that I spent in Montana a good-sized collection was secured.

Most of my time while in the field has been employed in the search for fossils, and I have never seen the corresponding Tertiary formations in other regions, yet I have made some observations that may be interesting. W. D. Matthews' paper, "Is the White River Tertiary an Æolian Deposit?" (*Amer. Nat.*, May, 1899), has added new interest to the study of these so-called lake bed deposits. There certainly is much mystery concerning their origin and the way in which the animal remains became fossilized. The fossils from Montana are different in appearance and are enclosed in a different matrix from those that are found in South Dakota. As has been said of the former (referring to color, etc.), "They do not look like White River fossils."

Most of the material in the beds that are undoubtedly White River is light colored, fine grained, and soft, though there are some layers of coarser and harder material. The same is true of the beds that, from their lithological characters and imperfect fossils, have been supposed to belong to the same horizon. The nearness or distance of the shore or the mountains and the character of the contiguous rocks seem to have little influence on the character or composition of the sediments.

I have made microscopic examination of samples from the several fossil-bearing beds, and all contain minute fragments undistinguishable from the glass fragments from the

beds of pure volcanic dust in the Loup Fork of Montana. It is very likely that the greater part of the deposits are a mixture of clay, fine sand and volcanic dust, with an abundance of calcareous matter in some places. Often, as previously stated, there are strata of limestone. In many places this limestone contains an abundance of fresh-water shells. These have not yet been specifically determined. Sometimes for a considerable thickness there is no distinct stratification, and in other places there are thin layers and distinct lamination. Near New Chicago, in thinly laminated shales, a few fish remains were found, and a little distance away, in a harder layer, fragments of bone, including part of a metapodial of an Oreodont associated with snails.

If the beds that do not contain fossil mammals, but have the same appearance as those that do contain them, are of the same age as the latter, there was a large area of deposition in Montana.

There has been considerable disturbance since the deposition of the White River beds, for in some places the strata dip at a high angle. I have not seen any distinct shore markings except in the vicinity of Missoula, where there was undoubtedly a lake in Pleistocene times.

The work on this paper has been done in the Museum of Princeton University, to which the greater part of my collection has been removed for study. It is due to the broad-minded interest of Prof. W. B. Scott that I have been enabled to do the work under such favorable circumstances, and his intelligent criticism has been of the greatest value to me. Dr. Marcus S. Farr, the Curator of Vertebrate Palæontology, has given me free access to the Museum and helped me in every possible way. The drawings of fossils were made by Mr. F. Von Iterson. The map was drawn by myself.

All the specimens described in the paper were found in Montana by myself and they are now in my collection, to which the numbers in the text refer.

PRINCETON MUSEUM, May 2, 1901.

DESCRIPTIONS OF SPECIES.

Ictops acutidens, sp. nov.

The type, No. 36 of my collection, consists of portions of a skull, mandible and other bones with a nearly complete femur, astragalus, calcaneum and one lumbar vertebra. It was a young individual. The epiphyses are free and the last lower premolar erupting. I do not know whether the last two upper premolars are permanent or temporary, but will describe them as they are.

If full grown the animal was smaller than *I. dakotensis** and differs from it in several

* Compared with specimen in the American Museum of Natural History.

respects. $P^{\frac{3}{}}$ is much larger and more complex, but it may be a temporary tooth. There are quite prominent antero-external cusps on the last two premolars and the first two molars.

Superior Dentition.—$P^{\frac{3}{}}$ has four sharp cusps, three of which—the protostyle, protocone and tritocone—are in an antero-posterior line. The protocone is the largest and is high and pointed. The tritocone is larger than the protostyle. The deuterocone is opposite the interval between the protocone and tritocone. This tooth is the longest of those that are preserved in the upper jaw.

$P^{\frac{4}{}}$, like the molars, is wider than long. It has four primary cusps—the protocone, tritocone, deuterocone and tetartocone—and three secondary ones—a protostyle and an anterior and a posterior median conule. The protocone and tritocone are high and pointed, the first being slightly the higher. The tetartocone is prominent but not high. The protostyle forms a small but distinct antero-external cusp. The protoconule and metaconule are plainly distinguishable (with a lens) on the protoloph and metaloph.

$M^{\frac{1}{}}$ is almost like $P^{\frac{4}{}}$ except that it is wider and the protoconule is merged into the protoloph which passes from the protocone to the parastyle. The metaconule is distinguishable. There is a small metastyle. $M^{\frac{2}{}}$ is wider than M^1 but not so long. There is only a trace of a metastyle. M^3 is small. The anterior elements are well developed, but the hypocone and metacone are much reduced.

Inferior Dentition.—The only premolar that is preserved is just erupting and is somewhat injured.

In all the molars the anterior cusps are much higher than the posterior ones. The protoconid and metaconid are connate at the base and the paraconid appears as a small anterior median cusp. The protoconid and metaconid are of a nearly equal height. In the heel or talonid the hypoconid is somewhat larger—has a greater antero-posterior diameter than the entoconid. The hypoconulid is median and small. The other molars are formed in the same pattern, but they decrease slightly in size posteriorly.

The infraorbital foramen opens above M^1, is narrow transversely and opens diagonally upward. It is in a longitudinal concavity which extends backward a short distance on the anterior part of the zygomatic arch. The posterior part of the foramen is only a little in advance of the anterior of the orbit. At the anterior upper margin of the orbit is a quite large protuberance.

The horizontal ramus of the mandible is narrow vertically. The angle projects downward and backward, the posterior angle being slightly hooked upward. The condyle is just above a line passing through the highest points of the molars. It is disk-shaped, the broad articular surface facing backward as much as upward. The coronoid process is broad. The tip is broken off. The anterior angle of the masseteric fossa is considerably behind the last molar and below the alveolar border. It is quite deep and

the anterior ridge prominent. On the inside of the mandible a convexity runs forward, dying out in a narrow ridge on the alveolar border under $M_{\overline{3}}$.

The great trochanter of the femur is not high. The lesser one is prominent posterior to and a little below the head. The third trochanter is small. The middle part of the shaft is nearly circular in section.

Measurements.

UPPER JAW.

	M.
Length of last two premolars and the true molars	.0137
Length of molar series	.0068
Length of P^2	.0034
Width of P^3	.0023
Height of crown of P^3	.002
Lenth of P^4	.0031
Width of P^4	.0033
Length of M^1	.003
Width of M^1	.004
Length of M^2	.0026
Width of M^2	.004
Length of M^3	.0016
Width of M^3	.0031

LOWER JAW.

Length of molar series and last premolar	.012
Length of molar series	.0085
Length of P_4	.0035
Length of $M_{\overline{1}}$	.0028
Width of M_1	.0021
Height of $M_{\overline{1}}$	.003
Length of $M_{\overline{2}}$	.003
Length of M_3	.0025
Width of M_3	.0019
Height of $M_{\overline{3}}$	.0024
Depth of ramus under M_1	.0051
Depth of ramus under $M_{\overline{3}}$	.0041
From posterior of $M_{\overline{3}}$ to posterior of condyle	.013
Length of femur	.046

Steneofiber hesperus, sp. nov.

Part of the left horizontal ramus of a mandible (No. 41) containing all the teeth. The tip of the incisor is gone. The specimen was found in a light colored sandy clay near Blacktail Deer creek, about thirty miles above Dillon in Beaverhead county. It was near the top of an exposure in which, a considerable distance below, were the remains of *Arretotherium*, to be described later, and part of the skull of a quite large rhinoceros.

The mandible is somewhat smaller than that of *S. pansus* of the Loup Fork of New Mexico. It is less robust, not being so deep or thick. The masseteric area does not extend so far forward. There is some difference in the enamel pattern of the teeth, but just how much is due to wear I cannot say. That of the premolar in the present species is more complex, being crenulate or minutely folded on the inner lakes and inflections. This tooth is smaller especially at the top, but much wear would bring this surface nearer to the area of that of *S. pansus*. The two anterior molars are broader and longer. The teeth do not appear so high from the outside, but are higher above the alveolar border on the inside. The outer enamel inflections do not extend so far down on the outside of the teeth, are more open and incline more forward and the outer lobes are more angulate. There are small extra enamel islets cn $M_{\overline{1}}$ and $M_{\overline{2}}$. There is no sharp antero-internal angle on the premolar. These comparisons are made with No. 10575 of the Princeton collection labeled *Castor pansus*, Camp creek, Oregon, which evidently does not differ at all from Cope's type from New Mexico (1877, p. 297, Pl. LXIX, Figs. 4 and 5).

In none of the teeth are the principal inner and outer enamel inflections converted into lakes.

At its preserved stage of wear the grinding surface of $P_{\overline{4}}$ has three divisions, an anterior outer, an anterior inner and a posterior. The anterior outer division is three-lobed, or is a crescent with a long limb extending inward and somewhat backward from near the posterior horn. The anterior horn is at the antero-external angle of the tooth. From this the crescent sweeps backward and inward, the outer border forming the outer margin of this part of the premolar. The inner limb extends transversely inward to the inner border. The anterior inner crescent of the tooth begins near the anterior border of the preceding one, the outer margin forming the anterior and anterior inner border of the tooth. On the posterior part of this crescent near the antero-external horn is a rounded lobe. Much wear would make the two anterior crescents confluent. The posterior part of the tooth is a transverse, pointed oval with the smaller end outward and slightly deflected forward. Its enamel lake has nearly the same form but with sinuous margin Much wear would perhaps make the enamel pattern nearer like that of *S. pansus*.

The enamel folds and lakes are inclined to be more curved and the enamel borders more sinuous than in *S. pansus*. There is an extra islet in the two anterior molars. In $M_{\overline{1}}$ it is posterior to the anterior lake and in $M_{\overline{2}}$ it is anterior.

The anterior surface of the incisors is more convex than in the beaver, *Castor canadensis*, and the antero-posterior diameter is proportionally greater.

Measurements.

	M.
Length of molar-premolar series	.017
Length of $P_{\overline{4}}$ at base	.005

	M.
Width of P_4 at base	.0045
Length of M_1	.004
Width of M_1	.0045
Length of M_2	.004
Width of M_2	.0042
Length of M_3	.004
Width of M_3	.0036
Depth of ramus under middle of P_4	.012
Depth of ramus under posterior of M_1	.011

Steneofiber complexus, sp. nov.

The type of this species is part of a skull and mandible with complete dentition (No. 42). It was found in a gray sandy layer in a ravine cutting through high bluffs of supposed White River age on the west side of the Madison river, in the Lower Madison valley, about nine or ten miles south of Three Forks. As this specimen and some limb bones of a rhinoceros-like animal are the only fossils of importance obtained here, and as the exact relations with the lower White River fossil-bearing beds northwest of Three Forks, about fourteen miles distant, have not been made out, it is impossible to say to just what horizon these beds belong.

This is a young individual. Only one premolar—the right upper one—has been shed. All of the molars are fully protruded and considerably worn. The upper permanent premolars are farther advanced than the lower, which evidently had only begun to grow.

This species seems to be nearest like Cope's *S.* (*Castor*) *peninsulatus* (1883, p. 840, Pl. LXIII, Figs. 18–21). The skull is damaged, yet some points of interest can be made out. There is a marked difference in the mandibles of the two species. In the present one the masseteric area does not extend so far forward, the anterior margin of the coronoid process rises opposite the back part of the third cheek tooth ($M_{\frac{2}{2}}$), and is nearer to the molars. This process has an entirely different form in the present species. It is high; the anterior border is straight and rises steeply. The angle is inflected inward and is rounded, not angulate anteriorly and posteriorly as in *S. viciacensis* (see Filhol, 1891, Pl. 5).

The Dentition.—The anterior face of the lower incisor is not so convex as in *S. hesperus* just described. The posterior angle is not so acute but is broadly rounded. The outer part of the cutting edge is rounded, not angulate, and the inner worn, beveled surface is long and longitudinally concave. Below this the transverse is just a trifle greater than the antero-posterior diameter.

The upper cheek teeth are very complex on account of the number and the curving of the enamel lakes and inflections and the sinuosity of the enamel. This might be simplified on further wear. The inner loops extend forward as much as outward, and some of

the lakes are nearly antero-posterior. In the lower teeth also the enamel of the lakes and inner enamel inflections is much lobed.

I will defer a detailed description of these teeth for a paper which has been partly written, describing several new species of Mylagaulidæ and throwing considerable light on their development.

Measurements.

Skull.

	M.
From anterior of incisor to posterior of M^3	.0384
From posterior of incisor to anterior of P^4	.021
Transverse diameter of incisor ..	.0032
Antero-posterior diameter of incisor	.0033
Length of molar-premolar series	.0123
Length of temporary P^4	.0033
Width of temporary P^4	.0038
Length of M^1	.0032
Width of M^1	.0035
Length of M^2	.0032
Width of M^2	.0034
Length of M^3	.0022
Width of M^3	.0032

Lower Jaw.

Anterior tip of incisor to posterior of M_3	.033
Length of molar-premolar series	.0146
Length of P_4	.0038
Width of P_4	.003
Length of M_1	.003
Width of M_1	.004
Length of M_2	.0032
Width of M_2	.004
Length of M_3	.0032
Width of M_3	.0033

Palæolagus Leidy.

In the Pipestone beds quite a number of jaws and teeth of *Palæolagus* were found. They apparently belong to three species. One has the third column on the lower molars as in *P. triplex*. The three portions of mandibles preserved are somewhat smaller than the one described by Cope (1883, p. 881, Pl. LXVII, Fig. 28), and may belong to a different species.

Several upper and lower jaws I cannot distinguish from *P. turgidus*.

Palæolagus temnodon, sp. nov.

There are three series of upper teeth (Nos. 43, 44 and 45) which differ in some respects from previously described species. They vary somewhat in size. P^3—the first

cheek tooth—has two anterior grooves instead of one. It lops backward, its upper posterior part resting against P^4. On M^3 of the largest one (No. 42) there is a rudiment of a posterior lobe. From Pipestone creek.

Measurements.

	No. 43.	No. 44.
	M.	M.
Length of molar-premolar series	.0123	.0141
Length of molar series	.0051	.0061
Width of M^1	.0004	.0045

Cylindrodon fontis, gen. et sp. nov. (Plate IX, Figs. 9, 9*a*.)

Of this rodent I have two portions of right mandibular rami (Nos. 38 and 39). One has all the cheek teeth and the greater part anterior to the ascending ramus; the other has the three posterior teeth and part of the ascending ramus, but not the angle, coronoid process or condyle. They were obtained from the Pipestone beds, associated with *Palæolagus*, *Ischyromis*, etc. The Pipestone springs, near where the fossils were found, suggested the specific name.

The diastema was short; the teeth are cylindrical with a central enamel islet and an outer enamel inflection. The lower border of the ramus is convex fore-and-aft, and is shallow but thick under M_3. The anterior angle of the masseteric area extends forward to M_1 and is near the alveolar border. The anterior border of the ascending ramus rises opposite M_3 and leaves a broad space between the two. The surface of the masseteric area is nearly flat, with a convexity considerably behind and above its anterior angle. On the inside, back of the teeth, from the horizontal ramus a large convexity passes backward, outward and upward on the ascending ramus. Above and below this the bone is thin. The mental foramen is small and is situated above the middle of the jaw, a little in advance of P_4.

The teeth are very characteristic, yet they are simple. As seen from above they look like a large comma, with a short tail directed outward. Their order of size, beginning with the smallest, is M_3, P_4, then M_1 and M_2, which are nearly equal in size. The teeth are evidently quite long vertically, except the last which is short, as it is so nearly approached by the posterior portion of the canine. The incisors are thicker anteroposteriorly than transversely.

Measurements.

	M.
Length of molar-premolar series	.0076
Depth of ramus under P_4	.0064
Depth of ramus just back of M_3	.0046
Thickness of ramus under P_4	.003

	M.
Thickness of ramus at $M_{\overline{3}}$	.004
Length of $P_{\overline{4}}$	.003
Width of P_4	.0021
Length of $M_{\overline{1}}$	.0031
Width of M_1	.0022
Length of M_2	.0021
Width of M_2	.0022
Length of M_3	.0014
Width of M_3	.0015

Sciurus jeffersoni, sp. nov.

Type No. 40.

This species is larger than *S. relictus* (Cope, 1883, p. 817, Pl. LXV, Fig. 35). The teeth do not increase regularly in size backward. The mental foramen is higher and nearer to the incisor. The diastema was shorter.

In this species the anterior cheek tooth is the smallest and the posterior one the largest, but the two between are nearly equal in size. In all of the teeth the anterior inner tubercle is the higher and larger and the posterior inner one the smaller. The latter does not appear as a separate tubercle on $M_{\overline{3}}$, as a continuous wall extends from the anterior inner to the posterior outer one, enclosing the basin internally and posteriorly. A small ridge, which may represent the posterior inner tubercle, extends from the wall backward and inward in the posterior part of the basin. On the anterior three teeth there are minute tubercles between the two internal ones. There are also minute median tubercles on the outer margins of all the teeth.

From White River beds, Pipestone creek.

Measurements.

	M.
Length of lower molar-premolar series	.012
Length of $P_{\overline{4}}$	.0026
Width of P_4	.0029
Width of molars, each	.003
Length of $M_{\overline{1}}$	.0029
Length of M_2	.003
Length of M_3	.004

Eumys minor, sp. nov.

The type of this species, No. 37, is part of a right ramus of a mandible from the Pipestone beds on Pipestone creek, in Jefferson county. The anterior part of the incisor is gone and all of the mandible back of the second molar. The two anterior molars are perfect.

This species is much smaller than *E. elegans* Leidy. The mental foramen is near the upper border of the diastema and apparently much in advance of the middle. The anterior angle of the masseteric area is under the anterior molar. Both teeth are somewhat worn on their grinding surfaces. Their antero-posterior diameters are nearly equal, but the second is broader transversely than the first. The anterior part of the first molar (cheek tooth) is not plainly divided into two lobes, but is subconical with a pit in the middle of the truncated apex. Its transverse is greater than its antero-posterior diameter. It is not much worn. It is smaller than the posterior portion of the tooth, in which there is a posterior outer tubercle, from which three slender lobes extend inward. The anterior lobe is the longest and the posterior the shortest. The second tooth has the two rounded outer tubercles and five slender inner lobes. It looks as if each outer tubercle sent in three inner lobes, but the contiguous two unite to form one median one. On looking at the grinding surface, it is not easy to make out the four principal lobes as it is in Leidy's figure of a tooth of *E. elegans* (1869, Pl. XXVI, Fig. 13). On examining the tooth from the inside it is seen that, beginning anteriorly, the second lobe forms the large anterior inner tubercle and the fourth the posterior one. The first and fifth are accessory, and the third is in the median valley between the two tubercles. It seems that a little further wear would unite the two anterior lobes.

Measurements.

	M.
Depth of jaw at mental foramen	.0031
Depth under second molar	.0039
Thickness under second molar	.0025
Length of first molar	.0015
Width of first molar	.0013
Length of second molar	.0015
Width of second molar	.0017

Hyænodon montanus, sp. nov.

Type No. 46.

A portion of a skull and mandible with all the teeth represented except the lower incisors. Found northeast of Toston, a village on the Missouri river, southeast of Helena. This was the only fossil secured from this stratum ; but teeth of two species of *Colodon* were found in lower strata. The skulls of *Oreodon robustum, O. culbertsoni* (?), and *Eucrotaphus helenæ* were found farther to the northeast, but I am not sure whether the beds are higher or lower.

Larger than *H. crucians ;* crown of upper canine nearly straight; crown of P^2 high and without posterior cusp; talons on $P_{\overline{3}}$ and $P_{\overline{4}}$, but not on $P_{\overline{2}}$.

The canine is long and slender but not curved backward toward the apex. $P^{\frac{2}{}}$ has a high crown as in *H. cruentus* and *H. horridus*. It has no heel and is therefore nearly like that of the former species. The anterior border is only slightly convex longitudinally. The posterior is concave as in that species. There is a small tritocone on $P^{\frac{3}{}}$, and the rudiment of a deuterocone supported by an inner root. In $P^{\frac{4}{}}$ the tritocone, the deuterocone and its supporting root are all larger. There is no antero-external basal cusp.

The lower canine curves backward. $P_{\frac{1}{}}$ is small and low, $P_{\frac{2}{}}$ bends backward. It is higher than $P_{\frac{3}{}}$. $P_{\frac{4}{}}$ is much larger and higher than $P_{\frac{3}{}}$.

Measurements.

UPPER JAW.

	M.
Length of upper series of teeth, exclusive of incisors	.094
Length of upper molar-premolar series	.083
Length of upper premolar series	.053
Length of upper canine	.012
Width of upper canine	.0083
Height of crown of upper canine	.026
Length of P^1	.009
Height of crown of P^1	.007
Length of P^2	.0125
Height of P^2	.014
Length of P^3	.0135
Height of P^3	.010
Length of P^4	.013
Height of P^4	.011
Length of M^1	.013
Height of M^1	.010
Length of M^2	.017
Height of M^2	.011

LOWER JAW.

Length of lower series of teeth, exclusive of incisors	.092
Length of lower molar-premolar series	.090
Length of lower premolar series	.052
Length of lower molar series	.039
Length of lower canine	.011
Width of lower canine	.0095
Length of P_1	.008
Height of P_1	.004
Length of P_2	.011
Height of P_2	.010
Length of $P_{\frac{3}{}}$	.0125
Height of P_3	.011
Length of P_4	.0133

	M.
Height of P_4	.012
Length of M_1	.0095
Length of M_2	.0105
Height of M_2	.010
Length of M_3	.017
Height of skull above M^1 about	.062

Hyænodon minutus, sp. nov.

Type No. 47.

This consists of only a lower sectorial tooth, but it is so minute that it cannot be confused with any known species, unless it be *H. mustelinus*, which is considerably larger. It is the second molar of the right side. It shows considerable lateral wear on the outside, showing that it was not a young animal. At the top of the cusp are two beveled, worn surfaces, where the white dentine shows through the black enamel. The dentine also is exposed on the anterior surface near the root. The tooth is thick in proportion to its length. There are minute ridges on the anterior angles and a faint median convexity. There is also a minute ridge in the posterior median surface. Probably the most characteristic thing is the size.

Measurements.

	M.
Antero-posterior diameter	.0075
Transverse diameter	.0049

From Pipestone beds near Whitehall, Jefferson county, Montana.

Colodon cingulatus, sp. nov.

Type No. 62.

Part of maxillary with P^3, P^4, M^1 and base of P^2.

A prominent cingulum entirely surrounds the last two premolars. The internal cusps—the deuterocone and tetartocone—are just beginning to divide, as indicated by a shallow furrow on the inner side. The protostyle, protocone and tritocone are all convex on the outside. The protocone and tritocone are nearly equal in size, but the protostyle is not so large or high. The metaloph is higher than the protoloph, the latter nearly dying out before it reaches the protocone. In other words, it ascends steeply as it passes outward toward the protocone.

In M^1 the paracone, parastyle, metacone and hypocone all appear as subconical cusps. The parastyle is much smaller than the paracone, and is situated in front of it and does not send backward a prominent cingulum on the outer face of the paracone as in *C. procus-*

pidatus. The distance from the apex of the paracone to the apex of the metacone is the same distance as from the latter to the apex of the hypocone.

There are at least two infraorbital foramina. They open in a concavity in the face above the third and fourth premolars.

From Toston beds near the Missouri river, above Townsend.

Measurements.

	M.
Length of last three premolars and first molar	.0407
Length of P^2 at base	.009
Width of P^2 at base	.012
Length of P^3	.0115
Width of P^3	.0173
Length of P^4	.012
Width of P^4	.0182
Length of M^1	.0145
Height of infraorbital foramina above alveolar border	.018
Distance between the two infraorbital foramina exposed	.0065

Colodon, sp.

No. 63.

A last upper molar in a fragment of the maxillary.

This is larger than *C. dakotensis.* The tooth is considerably worn. The parastyle is as large as the paracone and is more convex on the outer surface. The metacone is small. From Toston beds.

Measurements.

	M.
Length of M^3	.020
Width of M^3	.022

Bathygenys, gen. nov. (Plate IX, Figs. 7 and 8.)

Type Nos. 48 and 66.

Among the remains of small animals that were found in the Pipestone beds are two portions of mandibles that are of much interest, as, disregarding size, they are so very much like the corresponding parts of some of the Loup Fork specimens from Montana that I have put in the genus *Merycochœrus* (1900 and 1901). I have not made a careful study and comparison, but since seeing the fine specimens of *Merycochœrus* in the American Museum of Natural History, I think it is very likely that the Montana forms above referred to should be put in a new genus, so I will at present refer these to *Merycochœrus* with a question mark, as: *Merycochœrus* (?) *laticeps, M.* (?) *altiramus,* etc.

The parts of the present specimens are small, being anterior fragments of mandibles, yet these parts are so perfectly characteristic in *Merycochœrus* (?) that I cannot avoid the belief that if the skull of this animal is found it will show a strong leaning toward that genus, and I would not be surprised if it proved to be the White River ancestor. This is made more probable by the fact that none of the *Oreodontidæ* that have been described can be considered as ancestral to *Merycochœrus*, either the true genus or the doubtful one. I do not refer to the John Day forms, *Promerycochœri*, which have been included in that genus. They are a very different animal.

The specimens are (48) the anterior part of a right ramus of a mandible, with part of the alveolus of the canine, the root of $P_{\overline{1}}$, the alveolus of $P_{\overline{2}}$ and the last two premolars complete, and (66) a part of a right ramus with the last three premolars and the first molar.

There are four ways in which it differs from *Merycochœrus* (?). It is only a fraction of the size; it has, like some species of *Leptauchenia*, two mental foramina; the premolar teeth are not crowded, and the teeth are not so high. The premolar series was probably as long as the molar series.

In the form of the chin and symphysis, the depth of the jaw, the narrowness of the space between the rami back of the symphysis, the evident reduction of the incisors, the smallness of the canine, the lenticular section of $P_{\overline{1}}$, the forms of all the teeth preserved, their narrowness in proportion to their length, are all like *Merycochœrus* (?). It may be that these two fragments belong to different species, so to save confusion I will describe them separately.

Specimen 48.—The anterior upper tip of the ramus is broken off. This shows anteriorly a transversely narrow broken surface, nearly in the middle of which is the canine alveolus, but no hint of incisors. It is very doubtful if there was the full number. If there was they must have been exceedingly small or placed anteriorly to the canine. The anterior surface of the chin as far as shown is steep and straight along the symphyseal suture. It is convex transversely. The anterior mental foramen is beneath the posterior part of $P_{\overline{3}}$, the posterior one a little behind the middle of $P_{\overline{4}}$. They are a little above the longitudinal middle line of the ramus. The anterior is the larger. The symphyseal suture is broadest below and narrows upward as in *Merycochœrus* (?). The posterior of the symphysis is under the anterior part of $P_{\overline{4}}$.

The canine was evidently much smaller than $P_{\overline{1}}$. $P_{\overline{1}}$ is lenticular in section with nearly equal sides and rounded angles, the longest diameter being obliquely fore-and-aft, and directed posteriorly outward and anteriorly inward as in *Merycochœrus* (?). $P_{\overline{2}}$ had two roots near together. $P_{\overline{3}}$ has a proportionally large paraconid, which as the tooth is viewed from the outside is seen to be separated above by a distinct notch from the pro-

toconid. The deuteroconid is only represented by a narrow ridge passing part way down the tooth inward and backward from the apex of the protoconid. The metaconid is much better developed and is represented by a posterior tubercle, connected by a narrow ridge with the apex of the protoconid.

In $P_{\overline{4}}$ the paraconid is thicker and higher than in $P_{\overline{3}}$, and is inflected inward. The other four elements—the protoconid, metaconid, deuteroconid and tetartoconid*—are all well developed and surround a quadrangular cup-shaped depression. This is true also of *Oreodon* and *Eucrotaphus*, and the form of the tooth differs very little from these. In this particular tooth, however, the posterior depression would, on further wear, make an islet, not an enamel loop. It is shallow and would entirely disappear if there should be much wear. The great difference between this tooth and the corresponding ones of the above-named genera is in the narrowness of the tooth as compared with its length. $P_{\overline{3}}$ also differs in this respect and they are, therefore, more like *Merycochœrus* (?). $P_{\overline{3}}$ differs from that of *Oreodon culbertsoni* in the simplicity of the inner ridges—rudimentary deuteroconid—in this respect being much like the specimen I have examined of *O. gracilis*. It also differs in having the paraconid partly separated from the protoconid. Again in these slight variations the differences are in the direction of *Merycochœrus* (?). In the type of *M.* (?) *altiramus*, which I have described from the Loup Fork of Montana, the teeth are little worn and give an excellent opportunity for comparison (1901, p. 73, Fig. 1). The present species shows almost no advance on this pattern. The paraconid on the last two premolars is a little thicker, and this element is distinguishable on $P_{\overline{2}}$, which has just begun to develop the posterior elements. The teeth have all increased in height.

Specimen No. 66.—In this specimen the mental foramina are farther apart. The anterior one is under the anterior part of $P_{\overline{3}}$ and the posterior one under the anterior of $P_{\overline{4}}$. There is a thickening of the ramus—an outer convexity between these two foramina —not seen in No. 48.

$P_{\overline{2}}$ is shorter than $P_{\overline{3}}$ and the roots are not close together as in the other specimen $P_{\overline{3}}$ is about the same. $P_{\overline{4}}$ has the metaconid and tetartoconid much lower and they are not united at the posterior inner angle of the tooth, so that after considerable wear there would still be an opening to the inner basin as in *Oreodon* and *Merycochœrus* (?). $P_{\overline{3}}$ and $P_{\overline{4}}$ are broader than in No. 48.

$M_{\overline{1}}$ is shorter than $P_{\overline{4}}$. The posterior pair of crescents is wider than the anterior pair. The outer crescents are short antero-posteriorly.

I will propose for the specific name *P. alpha*, with No. 48 as the type specimen.

* The tetartoconid is small.

Measurements.

SPECIMEN 48.

	M.
Depth of jaw at angle of chin	.0155
Greatest width of symphyseal suture	.0083
Distance between mental foramina	.004
Thickness of ramus behind symphysis	.066
Length of premolar series	.0175
Length of P_1	.0042
Width of P_1	.0027
Length of P_3	.005
Width of P_3	.0022
Height of crown of P_3	.0026
Length of P_4	.0052
Width of P_4	.0031
Height of P_1	.0027

SPECIMEN 66.

Distance between mental foramina	.005
Length of last three premolars	.014
Length of P_2	.0042
Width of P_2	.002
Length of P_3	.005
Width of P_3	.0029
Length of P_4	.005
Width of P_4	.0037
Length of M_1	.005
Width of M_1 anterior	.0036
Width of M_1 posterior	.0042
Height of crown of M_1	.0024

Limnenetes, gen. nov.

The skull (No. 49) which I take as the type of this genus was found on a side hill about three miles northwest of Three Forks. It was near vertebræ of a small *Titanotherium*. The skull most nearly resembles *Oreodon gracilis* in size, yet it differs more or less from that species in most respects. The most striking characteristics are the following:

Skull low; frontal plane nearly flat; orbits open behind and as high as possible without arching of the frontal plane; a separate interparietal; tympanic bullæ large and longitudinally elliptical; basioccipital sharply angulate; zygomatic arches nearly parallel; sagittal crest low.

This skull belonged to an old animal and the teeth are so worn that their structure cannot be made out. There are other skull fragments with good teeth which were found in the same beds a couple of miles away. There are some differences, but I provisionally refer them to the same genus and describe part of them under the name of *P. anceps*.

Limnenetes platyceps, sp. nov. (Plate IX, Figs. 5 and 6.)

No. 49.

This is the skull on which the genus *Limnenetes* is founded.

Though the teeth are much worn it can be seen that the last two premolars are small. $P^{\frac{3}{}}$ is triangular, and $P^{\frac{4}{}}$ very short antero-posteriorly. The skull expands rapidly just anterior to the orbits and continues nearly the same width to the post-glenoid processes, giving this portion a rectangular aspect as seen from above. The anterior part of the nose is gone, so that only the posterior parts of the nasals are preserved.

The naso-frontal suture is short. From the naso-maxillary suture it extends backward and slightly inward, then nearly transversely to the median line, not forming a wedge. The nasals are narrow—not so wide as in *Oreodon gracilis.* They are flat on top as far as seen. The anterior lachrymal suture is nearly a semicircle. The lachrymal pit is shallow, and, with the orbital border just behind, is rugose. The supraorbital foramina are small and open a little less than one-third the distance from the frontal suture to the supraorbital border. The channels from these sweep forward and slightly inward, then outward and downward over the face, then backward to the infraorbital foramina which open above $P^{\frac{4}{}}$.

The frontals, though nearly flat, are slightly concave between the orbits with a low convexity along the frontal suture. Between the channels from the supraorbital foramina the surface is flat, but outside these convex.

The orbits are much larger than in *Oreodon gracilis.* They are circular and their upper borders lack only the thickness of the frontals above of being as high as the frontal plane—in fact they are about on a level with the slightly depressed median part of the frontal region. There are postorbital processes to the frontals and jugals, but they do not nearly meet, but end in points about 5 mm. apart.

The temporal ridges, beginning on the postorbital processes of the frontals, converge rapidly, then with a gentle backward curve meet about in the plane of the anterior borders of the glenoid surfaces. The parieto-temporal sutures follow these ridges for a little distance, then converging more rapidly form a wider angle in front of the stephanion. The sagittal crest is low, being highest just back of where the temporal ridges unite. Back of this it descends and becomes very low in front of the inion. A narrow median groove can be seen nearly the whole length. The inion is low—a little three-cornered area much lower than the frontal plane. Measuring from a line in the plane of the palate, it does not extend farther posteriorly than the occipital just above the foramen magnum.

The brain-case is full and well rounded out. It is broadest midway between the

middle transverse plane of the orbits, and the inion. Inward and backward from this are two convexities, one on each side of the higher part of the sagittal crest. The parieto-temporal suture makes a sigmoid curve upward and backward over the greater convexity of the brain-case and then extends backward parallel with the sagittal crest.

The interparietal is perfectly distinct from the other bones, having a well-defined suture all around. It is an equilateral triangle. The anterior angle is wedged in between the narrow, forked posterior processes of the parietals. It does not extend quite back to the posterior part of the skull, a narrow border of the supraoccipital intervening. The lambdoid ridges are low, not extending into wings.

The supraoccipital is nearly as broad as high. It is more nearly flat than in *Oreodon culbertsoni* or *O. gracilis.* Above it is slightly concave, with a hint of a median ridge. Below it is broadly convex and almost flat above the foramen magnum.

The basioccipital is narrow and sharply angulate below, the angular portion being in the same plane as the palate.

The tympanic bullæ are near together, large, high, evenly rounded, elliptical in outline, as seen from below, with the longer axis antero-posterior; and they project downward farther than any other elements of the skull.* They are proportionally larger than in *Eporeodon* (Princeton Col., No. 10586). The external auditory meatus is trumpet-shaped like that of *Oreodon culbertsoni,* and it fills the space between the exoccipital and the post-glenoid process. The foramen ovale is above the anterior portion of the tympanic bulla. The foramen rotundum is small and just outside the posterior beginning of the pterygoids.

The posterior nares open between the anterior lobes of the last molars. The posterior median portions of the palatines end in a blunt point. The palate is concave in a transverse line and narrow. The posterior palatine foramina are between the interval between the last premolars and first molars.

The glenoid surface is somewhat convex antero-posteriorly, about the same as in *Oreodon culbertsoni.* The post-glenoid processes are broad transversely, bounding the whole glenoid surface posteriorly and extending outward nearly as far as the maximum expansion of the zygomatic arches, which is just anterior to the glenoid surface.

As before stated, the skull is very nearly the size of that of *Oreodon gracilis.* Its likeness to that seems more apparent on hasty examination than after detailed study. In many respects, as in the flatness of the top of the skull, the large size and superior position of the orbits, the shape of the brain-case and the size and form of the tympanic bullæ, it more resembles *Eporeodon* (?). In a specimen of this genus (Princeton Coll., No. 10568) which I have used for comparison, the postorbital processes of the frontal and

* Probably the paroccipital processes extended lower, but they are broken off.

jugal are but barely united, so that the present specimen comes nearer to *Eporeodon* (?) in this respect.

The beds from which this fossil was obtained are undoubtedly older than the Oreodon beds of South Dakota and very likely correspond to the lower Titanotherium beds; yet it is very doubtful whether this form is directly ancestral to *Oreodon culbertsoni* or *O. gracilis*, though I should say that it is more closely related to the latter. It is more probable that it is ancestral to *Eporeodon*, and that at least the forms with excessively large bullæ form a separate line from the Unita. But it is difficult to make comparisons or draw conclusions on account of the chaotic condition of this family. It probably will remain so until some one who can do it properly can have the opportunity of studying the vast amount of material that has been collected and who will undertake the enormous task of "straightening things out." There are about twenty species belonging to this family that have been found only in Montana.

Measurements.

	M.
Length of skull from anterior of P^3 to posterior of occipital condyle	.085
Length from back of M^3 to back of same	.049
Width of skull at fourth premolars	.030
Width of skull at third molars	.062
Width of skull just anterior to glenoid surfaces	.065
Height of skull at fourth premolars	.025
Height of skull at centre of orbits	.030
Height of skull at occiput	.033
Width of skull between middle of orbits	.037
Width of brain case	.0895
Diameter of orbits, antero-posterior	.020
Diameter of orbits, vertical	.020
Length of P^3	.0055
Width of P^3	.0055
Length of P^4	.005
Width of P^4	.0077
Length of M^1	.008
Width of M^1	.010
Length of M^2	.010
Width of M^2	.011
Length of M^3	.011
Width of M^3	.012

Limnenetes (?) *anceps*, sp. nov.

About two miles from where I found the type skull of *L. platyceps* I found several fragments of skulls and mandibles of *Oreodontidæ*. They were found in the same spot, but belong to at least five different individuals. One was a small *Agriochœrus*, *A. minimus*, which will be described in this paper. In the same place were toe bones and part

of the femur of a rhinoceros, probably a small *Cœnapus*. A little distance away were remains of a *Titanotherium*. A mile or two farther north were quite a number of *Titanotherium* bones and there I obtained large portions of two skeletons.

The specimen which I take as the type of this species is the greater part of the anterior portion of a cranium (No. 50). Part of the snout and right maxillary are gone, but the root of the canine on the right side and the last two premolars and all the molars on the left side are preserved. It is only a little smaller than *Oreodon gracilis*.

Compared with *L. platyceps*, the frontal plane is still more flat but narrower; the lachrymal depressions are larger, deeper and different in shape; the infraorbital foramen is farther forward, being above P^3 instead of P^4; the nasals are different in shape and extend farther back.

The nasals are narrow, but broadest between the slender tips of the frontals. From here they narrow anteriorly to where they are broken off, and posteriorly to where they end in two small tips separated by a small wedge of the frontals. The latter, of course, may be only an individual character. This posterior extension of the nasals with the narrowness of the top of the skull make the anterior projections of the frontals rather long and narrow, and they end in slender tips which are wedged in between the nasals and the maxillaries. The lachrymals are larger than in *L. platyceps*, are not so nearly semicircular and they send up a peninsula of bone toward the nasals. The lachrymal depressions are deep and longitudinally elliptical. The teeth are so much like those of *Oreodon gracilis* as not to need a separate description. Compared with the specimen (Princeton Col., No. 11396) which I have used for comparison, P^2 is a little more triangular and the median and anterior outer horns of the crescents are less prominent. One of the supraorbital foramina is farther back than the other, and shallow channels can be traced to the infraorbital foramina as in *L. platyceps*.

Among the other fragments is part of a skull (No. 52) that appears to be different from either of the preceding, but it belongs to a young animal. A small part of the postorbital process of the frontal is gone, but it was undoubtedly short and the orbit open behind.

There is also a series of milk teeth (No. 51), but not enough of the skull to determine the species.

Measurements of type specimen.

	M.
Length of dental serics, exclusive of incisors	.054
Length of molar series	.028
Length of canine	.005
Width of canine	.0045
Length of P^3	.006
Width of P^3	.0065

	M.
Length of P^4	.006
Width of P^4	.008
Length of M^1	.008
Width of M^1	.010
Length of M^2	.010
Width of M^2	.012
Length of M^3	.0095
Width of M^3	.0125
Width of nasals, greatest	.0112
Width of skull between anterior of orbits	.030
Diameter of lachrymal depressions, antero posterior	.013

Oreodon robustum, sp. nov.

Type No. 56.

The greater part of a skull found in bed of soft sandy clay, northeast of Toston, near the Missouri river, southeast of Helena.

It is readily distinguished from other species by several characters.

Distinguishing characters: *Size large; face and anterior nares deep vertically; nasals broad; zygomatic arch broad below orbits; palate broad; foramen ovale extremely large; tympanic bullæ very small and separated from basioccipital by a wide space; incisive foramina broad oval.*

The canines agree with the general robustness of the skull in being large. The crowns are not preserved. P^1 is narrow. P^2 is a little different from that of *O. culbertsoni*. It is narrower. The anterior festoons are smaller, there being two little pits, but the ridge or partition that divides them does not continue downward on the tooth. On account of the thinness of the principal cusp the posterior internal festoon encloses a larger area.

On the premaxillaries, beside the narial openings, are quite large depressions, which in their centres expose a small surface of the anterior roots of the canines. It looks as though the premaxillaries had begun to cossify. The height of the anterior nares and of the face are very marked. The nasals are broadest above the anterior parts of the lachrymal depressions. From here they are narrowed backward very regularly, ending in points. Their posterior portions form a convexity. The supraorbital foramina are farther apart than in *O. culbertsoni*.

The roof of the brain-case is broken away, showing part of the cast of the cerebrum and cerebellum.

The tympanic bullæ are similar to those of *O. culbertsoni* in form. The posterior portion, which abuts against the paroccipital, forms a process which extends downward a short distance in close contact with this larger process. Another process extends down-

ward opposite the post-glenoid. It is thin and antero-posteriorly compressed. A hint of it is seen in *O. culbertsoni* (Princeton Col., No. 10062). Another process extends backward and outward near the postero-interior face of the post-glenoid. A much larger space is left between the tympanic and the basioccipital than in *O. culbertsoni.* The ridge or convexity that bounds the inner side of the glenoid surface is much more prominent than in that species. The basioccipital is broader.

Measurements.

	M.
Length of skull from front of canine to back of paroccipital process	.192
Height of skull above P^1	.060
Height of skull above M^1	.064
Width of skull at canines	.055
Width of skull at anterior of orbits	.104
Height of narial opening over P^1	.040
Width of narial opening over P^1	.030
Width of molar under middle of orbit	.022
Width of palate between canines	.039
Width of palate between second premolars	.040
Width of palate between last molars	.037
Width of incisive foramina	.0095
Length of incisive foramina	.012
Length of foramen ovale	.009
Width of foramen ovale	.005
Length of molar-premolar series	.090
Length of premolar series	.045
Length of molar series	.045
Width of P^1	.006
Width of P^2	.0085
Width of both nasals, greatest	.030

Eucrotaphus helenæ, sp. nov.

Type No. 57.

The skull with the lower jaw. The anterior part of the skull and mandible, the occipital crest and zygomatic arches are gone. It was found northeast of Toston, in a bed of clay which contained nodular layers.

It was a young individual but nearly full grown, judging by the sutures of the skull. It has its temporary premolars. All the molars are fully erupted, but the last molars are unworn.

The nasals are quite broad above the third premolars. They narrow gradually and uniformly backward, ending in points in a plane with the anterior of the orbits. They are convex. The lachrymal pits are nearly circular and quite deep. The anterior prolongations of the frontals terminate in a plane with the fourth premolars. The lachrymal

is very large. The supraorbital foramina are farther apart than in *Oreodon culbertsoni*. The orbit is circular. The forehead is convex between the orbits, but concave in front of the stephanion. The brain-case is broad, full, and well rounded out. There are no distinct ridges near the parieto-temporal sutures. The anterior part of the sagittal crest is low. The brain-case here is full and arched upward. Back of this the crest is broken away, but evidently it was not high and narrow, as in *Oreodon culbertsoni* or the so-called *Eporeodon* of the White River or John Day. It appears to have been more like that of *O. gracilis*. The foramen magnum is large. The basioccipital in front of the condyles is broadly convex, then for a short space forms a rounded (not a sharp) angle, then is broadly convex again between the tympanic bullæ. The bullæ are large, but not so large as in *Eporeodon* (?) *major*. They are quite evenly rounded and longer antero-posteriorly than transversely. Posteriorly they abut against the paroccipital processes, which extend backward and outward. These processes are convex postero-internally and deeply concave antero-externally toward the bases. The post-glenoid processes are moderately thick. The posterior nares open between the posterior parts of the last molars.

The horizontal rami of the mandible are widely separated just behind the symphysis as in *Eporeodon*, but the caniniform premolars are very much nearer together and are nearly circular in section. The angle descends below the horizontal ramus. The coronoid process is narrow at its base and the condyle is a short distance behind it, making the sigmoid notch and the upper part of the mandible narrow antero-posteriorly as compared with *Eporeodon* (Princeton Col., 10586). The upper molars have very prominent outer horns to the crescents.

This animal resembles both *Oreodon gracilis* and *Eporeodon*, which perhaps form a different line from that of *O. culbertsoni*, but the latter is so variable and the validity of *Eporeodon* is so doubtful that I will not attempt the task of making comparisons. Even if *Eporeodon* is a valid genus this animal is quite different, and I prefer to use the older name *Eucrotaphus*.

Found in Toston beds in Broadwater county.

Measurements.

	M.
Length of skull from anterior of P^2 to posterior of occipital condyles	.158
Length from back of last molar to back of condyles	.080
Width of skull at middle of orbits	.104
Width of postorbital constriction	.035
Width of brain-case, greatest	.055
Width of condyles	.038
Width of foramen magnum	.021
Width of palate at last molars	.040
Length of paroccipital processes	.027

	M.
Length of bullæ, antero-posterior	.021
Width of bullæ	.016
Length of last three temporary premolars	.033
Length of molar series	.047

Agriochœrus maximus, sp. nov. (Plate IX, Fig. 4.)

Type No. 58.

Of this animal there is a right molar-premolar series and the last two premolars and the first two molars of the left side, with some small skull fragments. They were found on the Little Pipestone, southwestward from Whitehall. These teeth do not look like those of *Agriochœrus*, principally on account of their lowness and plain, flat appearance; yet when they are compared one by one with those of *Agriochœrus*, one does not feel warranted in establishing a new genus on these alone; though if a skull and skeleton were found, I have little doubt that the animal might prove to be a different thing.

Distinguishing characters: *Size large; teeth plain; the cheek teeth low, except* P^1, *made up of crescents which are approximately low three-sided pyramids with broad bases.*

P^1 subconical, longer than wide, with an anterior angle and a posterior depression; two-rooted. P^2 simple, pyramidal; the outer side convex; the antero-inner nearly flat; postero-inner side concave, with a weak cingulum. P^3 three-rooted, with a small deuterocone. The two inner sides equal. There is an incipient tendency toward the division of the outer crescent, as seen in the slight inner groove just behind the inner angle and the apex of the protocone. P^4 has the same length as P^2 and P^3 but is broader. The two outer crescents are not separated down as far as in the molars. The deuterocone is as large, though not as high, as the outer crescents. It is subconical or subtriangular in section. There is a trace of a tritocone which looks like a cingulum. There is a faint cingulum nearer to the root.

M^1 has short, broad, low crescents, with broad open valleys between. M^2 and M^3 are the same but longer antero-posteriorly. The animal was not old, as M^3 had been recently erupted.

A small portion of the top of the skull shows the angle where the temporal ridges unite to form the sagittal crest. In the angle is a broad concavity and the ridges are broad and prominent. There is no deep groove at the angle. The anterior part of the sagittal crest is a low, broad convex ridge.

Measurements.

	M.
Length of molar-premolar series about*	.124
Length of premolar series	.052

* The posterior half of M^3 is injured, and it is reckoned as the same length as the anterior part.

	M.
Length of molar series about*	.070
Length of P_4	.0105
Width of P_4	006
Height of crown of P_4	.009
Length of P^2	015
Width of P^2	.0103
Height of crown of P^2	.0095
Length of P^3	.015
Width of P^3	.014
Height of P^3	.0105
Length of P^4	.015
Width of P^4	.017
Length of M^1	.019
Width of M^1	.022
Length of M^2	.0245
Width of M^2	.027
Height of M^2	.008
Width of M_3	.030

Agriochœrus minimus, sp. nov.

Type No. 59.

As *A. maximus* is the largest known *Agriochœrus*, if it is an *Agriochœrus* at all, so this species is the smallest. It is represented by the molars, last two premolars, and the zygomatic arch of the right side belonging to a mature individual. It was found in the White River beds, northwest of Three Forks, with *Limnenetes anceps*.

Specific characters: *Size small; P^3 long antero-posteriorly; outer crescents of molars very low, their outer faces looking downward much more than outward.*

P^3 as seen from above is nearly a right-angled triangle, with the right angle placed postero-externally. The outer surface of the protocone is concave with a faint ridge in the median line of the tooth. The tritocone is distinguished from the protocone as viewed from the inside, though it is not so apparent from the outside; but the protocone is the larger, the groove being behind the apex. The deuterocone is well developed and is opposite the tritocone. A ridge extends from its apex and along the inner side of the protocone to the anterior angle of the tooth. There are traces of a cingulum in the anterior and posterior faces of the deuterocone, and at the posterior outer base a small hint of a tetartocone.

P_4 is nearly an equilateral triangle in cross section with a rounded interior angle, as the deuterocone is conical. The separation of the protocone and tritocone has progressed farther than in P^3; the two are more nearly equal. This is apparent from

*The posterior half of M^3 is injured, and it is reckoned as the same length as the anterior part.

the outside in the truncation of the apex of the tooth. A protoloph begins at the apex of the deuterocone, and, becoming narrower and lower, extends to the outer anterior buttress. The tetartocone is small but well defined. A cingulum surrounds the inner part of the tooth.

The molars are broader than long. They bear very low crescents. The antero-external buttresses are large, especially on M^3. There are inner cingula on M^2 and M^3 and faint traces on M^1.

The zygomatic arch is quite broad under the orbit; its lower angle being opposite the posterior part of M^2. The anterior inferior root expands outward abruptly. One root of M^3 projects through the maxillary into the orbital plane. Evidently the posterior of the orbit was in the same plane as the posterior of the last molar.

Measurements.

	M.
Length of last two premolars and molars	.0400
Length of molar series	.0250
Length of P^3	.0075
Width of P^3	.0062
Height of crown of P^3	.0047
Length of P^4	.007
Width of P^4	.0084
Height of P^4	.0042
Length of M^1	.0085
Width of M^1	.009
Length of M^2	.0088
Width of M^2	.0105
Height of M^2 and M^3, each	.003
Length of M^3	.0103
Width of M^3	.012
Greatest width of zygomatic arch under orbit	.013

Arretotherium acridens, gen. et sp. nov. (Plate IX, Figs. 1-3.)

Type No. 60.

Of this unique animal I have most of the superior dentition and parts of the skull and skeleton. It was found in a fine sandy clay near Blacktail Deer creek, twenty-five miles south and east of Dillon, in the southwestern part of the State. Part of the posterior portion of a skull of a rhinoceros—probably *Cœnopus*—about the size of *C. tridactylum*, was found in a sandy layer near, and a considerable distance above the type of *Steneofiber hesperus* was obtained. The bones are much broken and part of them had been washed out and mixed in confusion in the clay. I saved all the fragments I could find, taking some of the material to the creek and "panning it out."

Part of the humerus of a cat, besides fragments of bones of one or two other animals, are mixed with those of this specimen, so it is sometimes difficult to be sure just what ones belong with it.

The teeth are different from those of any known animal. Those of *Hyopotamus* resemble them, especially the molars; but those of the present genus have no anterior intermediate "fifth" or "unpaired lobe," the protoconule. In this respect they are like *Merycopotamus.*

With the material in hand the principal characters seem to be the following:

All the upper teeth with sharp cusps or crescents; first premolar small; premolars increasing rapidly in size posteriorly, and composed of a simple compressed cone and a cingulum or cingulum-like cusp, which also increases in size backward; molars high, square in section, their length and breadth being nearly equal; occiput low; tarsus in the main resembling that of Oreodon.

Dentition.

The only incisor preserved resembles the third of *Hyopotamus*, but it is much smaller and proportionally much thinner. The outside of the crown is uniformly convex. The inner side has a low, broad median convexity, so that, though thin, the tooth is thickest a little behind the middle and the edges are very thin. The anterior edge projects a little beyond the root.

Parts of two canines were found, the upper part of one and the lower part of the other. They were supposed to belong with the other teeth, as they were found closely associated with them. They are thin and sharp for an artiodactyl, yet not altogether exceptional, and they are quite sharp and finely serrate on the posterior edge. These characters, and the fact that part of a humerus of a cat was found with the other bones, makes it doubtful to what animal these canines belong. But when one sees the compressed character of the incisor and premolars and the sharpness of the apices of the molar crescents, it does not seem improbable that the canines belong to the present animal. The teeth are not more compressed than in *Moschus*, and not so long as in that genus or *Cervulus.* The serrated edge is not entirely exceptional, as Marsh has observed it in *Elomeryx armatus* (1894, p. 178, Fig. 3). The form of the tooth is not very closely like that of any cat I have seen. The whole length of the anterior edge of the crown is worn by contact with the lower canine. This, I think, does not occur in any of the cat tribe, as, at most, on account of the inner position of the lower canines and their obliqueness, only the base of the anterior part of the corresponding upper tooth could be worn by contact. The relative position of these teeth was evidently similar to that in the Peccary.

The canine is narrow laterally, more nearly flat on the inner surface and divided into three convexities by two faint longitudinal furrows. The outer surface is more convex, divided in the same way, but the middle convexity is much greater. The tooth contracts uniformly anteriorly, exteriorly and posteriorly from the base upward, ending in a small, smooth, rounded point. The appearance of the enamel is like that on the rest of the teeth, in all of which the inner angles and sometimes the outer are smooth, the other inner surfaces less so; while on the outer surfaces the enamel is slightly crinkled. The height of the crown was about .035 m.

The first premolar is small, longer antero-posteriorly than the incisor, and is thin—the thickest part and the apex being slightly anterior to the middle. The forward slope of the edge from the apex is straight, but back of the apex it drops abruptly, then slopes backward and curves downward. The thin anterior part, as in the incisor, projects a little anteriorly to the root. There is a short cingulum on the posterior inner side, which continues as a faint ridge to the anterior edge of the tooth.

Premolar 2 is longer antero-posteriorly and much higher, having a high, narrow apex, which is nearly central. From this apex the edges descend, vertically anteriorly and nearly so posteriorly for a short distance, and then both slope away, though not with exact symmetry, to the anterior and posterior edges of the tooth at the base of the crown. The outer convexity is not straight vertically. Beginning at the apex it extends downward a short distance, and then curves forward. The inner convexity is straight and median. There is an outer cingulum. The inner cingulum begins at the anterior angle of the tooth, but the posterior part is broken away.

The third premolar is nearly an enlarged copy of P^2. It is larger in every way. The main cusp is rather narrow, but the enlargement and expansion of the cingulum on the posterior inner part of the tooth gives the base a triangular form, with the posterior inner angle rounded. The cingulum encloses a large concavity or an oblong cup-like depression. A second premolar of a young *Hyopotamus* in the Princeton Collection (No. 10652) resembles this tooth.

P^4 has an outer and an inner crescent, the outer being the larger, longer and higher. There is an anterior and a posterior outer buttress at the outer angles. Both the anterior and posterior cingula are large and enclose furrows between them and the crescents. The outer crescent is concave externally with a median convexity. This is also true of the inner crescent. The posterior faces of the crescents are in the same plane. The anterior horn of the internal crescent is convex on the anterior face, and abuts against a small but comparatively high conical cusp or style which partly interrupts the valley between the two crescents.

As before stated, the molars have four crescents with no fifth lobe, and the length and width are nearly equal. As nearly as I can judge from the illustrations of Falconer and Cantley (1847, Part VII, Pl. LXII, Figs. 15 and 17), the last two molars are considerably like those of *Merycopotamus dissimilis*, but here the close similarity apparently ends.

Molar 1 is so much worn that little can be said of it, except that it is much smaller than M^2 and is square in section. The anterior and posterior worn surfaces are confluent medially, and only the last narrow traces of the transverse valley are preserved, one as an external, the other as an internal projection, not quite meeting on the middle transverse line.

In the third and fourth molars the inner crescents embrace the inner bases of the external crescents, so that the median transverse valleys are much deeper than the median longitudinal ones. There are buttresses on the external horns of the external crescents; but the two median ones do not conjoin, forming a large one which cuts off the external entrance to the median transverse valley as in *Hyopotamus*. Owing to this and to the depth of the median valleys, the anterior and posterior halves of the teeth seem much more separated from each other than in that genus; in fact the last molar, especially, is almost cut in two. From the inner faces of the anterior inner crescents a short but thick cingulum extends backward and slightly outward, abutting against the anterior face of the posterior inner crescent. The anterior and posterior cingula are strong, and the depressions or valleys which they enclose are divided by the horns of the inner crescents. In the last molar the anterior horn of the posterior inner crescent continues to the anterior outer crescent, thus dividing the bottom of the transverse valley by a thin partition. The anterior roots of M^2 are connate, thus forming one broad root. This probably is true of others, but they are not enough exposed to make it certain.

Three molars on one side and the last two on the other have part of the jaws attached. The incisor, canines and premolars were found separate. There are many fragments of molar teeth of the same kind, so there must have been more than one individual.

A fragment of a mandible is present which has one imperfect tooth. It is doubtful if this belongs to the same animal as the upper teeth. It looks more like the tooth of some member of the *Pecora* than we would expect to see in this animal. It is prismatic and quite high. In section each half of the tooth is a three-sided prism, the outer crescents being V-shaped at the top, but the outer angle becomes rounded below. On one of the outer crescents or plates there is a ridge that is not exactly median, as it begins below at the base of the posterior buttress, passes diagonally upward and forward, terminating in front of the apex of the crescent. This is probably $M_{\overline{2}}$.

The Skull.—A portion of the base of the skull is preserved, including part of the occiput, the occipital condyles, the basioccipital, the exoccipitals and small portions of the squamosals.

The occiput was low as in *Hyopotamus*, which it much resembles in some respects. The occipital condyles and foramen magnum are large. Their lower articulating surfaces are nearly flat medially. They form only a slight angle with the part of the basioccipital anterior to them. Between the paroccipital processes the basioccipital is broad and moderately convex. Anterior to this it is broad and quite thin. There is a longitudinal groove on the under side on the median line on the portion between the tympanics.

The exoccipitals are similar to those of *Hyopotamus*. They are broad and thin above, convex transversely and concave vertically. They are peculiarly roughened, appearing as if they were made up of several coössified bony plates. The paroccipital processes are both broken off, but they are nearly equilateral triangles in section, nearly on a level with the inferior surfaces of the occipital condyles. They are directed slightly backward as in *Hyopotamus*. The exoccipitals are transversely convex posteriorly and concave—except at the top—anteriorly, but they send forward a high ridge or wing which rests against the tympanic internally. This latter bone is tightly wedged in between this process, the outer part of the basioccipital and the squamosal.

The external auditory meatus is small and extends inward horizontally just beneath the lambdoid crest. Aside from this the space between the exoccipital and squamosal is entirely filled with bone. The two processes, the paroccipital and post-glenoid, do not approach each other as in the American species of *Hyopotamus*. Apparently the arrangement here is more like that in the fragment of skull figured in Kowalevsky's paper on *Hyopotamus*, in Pl. XXXIX, Fig. 5 (1873). The tympanic fills the greater part of the space above referred to. There is a groove extending downward and forward which appears to be a line of bony union, so that the portion anterior to this line may be a triangular exposure of the periotic. The bullæ are not preserved, but portions of the petrous were found which show that this bone was very large. One fragment shows a cast of the cochlea. The first whorl is much larger and is broader than either of the others, which are almost equal in size of whorl, but the third is slightly thicker. The first whorl is .005 m. in diameter and its greatest thickness .0015 m.; third whorl .003 m. in diameter.

The Atlas and Axis.—Only parts of these two vertebræ are preserved. The atlas has an extremely large neural canal, but a considerable portion was occupied by the large, broad and thick odontoid process of the axis. The floor of the canal is convex fore-and-aft, with a median transverse ridge bounding anteriorly the articular surface for the odontoid process. The anterior cotyles, if not confluent below, are almost so and are not separated

by a groove. The lower surface of the atlas is nearly flat with a median anterior convexity, evidently terminated by a short spine or protuberance which has been broken off. The posterior cotyles for the axis are nearly flat, and, like the anterior ones, are almost confluent below.

The odontoid of the axis is broad and thick. As stated by Scott in the case of *Hyopotamus brachyrhyncus* (1895, p. 470), it is "neither conical nor spout-shaped, but intermediate between the two." It is broad and thick. A section at the base, also the anterior edge, are almost semicircles, so the process is approximately the sector of a sphere. The upper surface, however, is not flat, but somewhat irregular. Anteriorly it is beginning to be spout-shaped, but there is a broad median convexity. Farther back at the base is a greater prominence, terminating anteriorly in two V-shaped convexities, one on each side of the median line. With the exception of this prominence and its greater width, this process resembles that of *Agriochœrus*. The atlanteal surfaces of the axis are convex ventro-dorsally, and they slope backward more than in the last-named genus.

The Humerus.—The head is unusually flat on the articular surface, the convexity being mostly on the inner portion. The lower portion differs both from the one described by Scott as *Ancodus brachyrhyncus* and the one figured by Kowalevsky as *Diplopus* (1873, Pl. XXXVI, Fig. 4). The inner epicondyle is very uneven on the outer surface, being covered with irregular ridges and depressions. It is much thinner than in *Hyopotamus* and different in shape. Instead of being broad posteriorly to its lower extremity it has a narrow border. The trochlea is also different. The median ridge is almost as prominent as the inner one. The outer convexity is small and looks like an accessory ridge on the median one. The inner groove is deep and the ridges are not oblique.

The Tibia.—The distal end is compressed antero-posteriorly, its transverse being nearly twice its other diameter. The facets for the astragalus are very oblique, the inner one being narrower and deeper than the outer. The outer edge of the tibia is angulate to near the astragular facet, where there is a small oblique truncation. This evidently was not for the shaft of the fibula, as that lay in the broad convexity anterior and internal to the outer angle.

The Fibula.—The lower end of the fibula is laterally compressed. Its antero-posterior is twice its other diameter. There are on the outer side an anterior and a posterior ridge and a smaller one on the plane surface between. The facet for the calcaneum is oblong-oval or hastate, terminating posteriorly in a point. There is a posterior concave surface and a smaller anterior convex one. The facet for the astragalus is different from that of *Diplopus* (Kowalevsky, 1873, Pl. XXXV, Fig. 3), being more like that of

Oreodon. It is a lobe extending backward and upward and is broadly rounded at the extremity, not forming a half crescent as in *Diplopus.* It has no raised border or ridge projecting over the upper edge of the outer ridge of the proximal trochlea, as in the specimen No. 11162 of the Princeton Collection, the foot of which is figured in Scott's paper (1895, Pl. XXIV, Fig. 9). This articular surface occupies an elevated plane. The posterior side of this elevation is higher than the anterior.

The Tarsus.—The tuber of the calcaneum is most like that of *Oreodon,* but is much more robust in proportion to its length, especially so at the upper extremity. It is like that, too, in having no tuberosity or accessory facet on the sustentaculum, the inner border of which is a sharp angle all around.

The astragalus is longer in proportion to its width than in *Agriochœrus,* but much shorter than in *Hyopotamus* or even *Oreodon.* In other respects it differs little from that of *Oreodon.* The oblique ridge above the calcanear facet is not so prominent. As in *Oreodon,* there is a faint ridge defining the inner boundary of the facet for the calcaneum, but no massive ridge with an accessory facet as in *Hyopotamus* or *Agriochœrus.*

The cuboid is much like that of *Oreodon,* but the calcanear notch is very shallow, not descending so low as in that genus. In *Hyopotamus* it descends still lower. As seen from the front the notch occupies only one-third the width of the cuboid, and it apparently did not reach backward more than half the antero-posterior thickness of the bone. The cuboid is more regular in outline and much nearer a cube than in *Hyopotamus, Agriochœrus* and *Oreodon.*

The navicular is more like that of *Hyopotamus,* but there is no plantar hook. Behind the proximal articular surface there are two lobes, as a valley runs down the plantar side. The inner lobe is the larger, projecting backward, so that the inner length of the bone is greater than that in *Hyopotamus.* The distal surface is nearly a plane surface, with the exception of a small median inner convexity. The inner side is more regular than in *Hyopotamus.*

The ectocuneiform is nearly like that of *Oreodon.* There is a small facet for metacarpal II, which has two faces, one more concave than the other. Above this is a small triangular facet for the mesocuneiform. On the plantar side there is a wide groove or valley, passing obliquely downward and inward from the proximal to the distal surface.

The tarsus, as far as preserved, is characterized by its plainness and lack of complication. Unless the meso- and entocuneiforms were larger than common, there must have been a large median plantar space unoccupied by tarsal bones. We have not the proximal ends of the metacarpals, so it cannot be ascertained whether there were any posterior prolongations filling this space or not.

There are no complete metapodials. There are the proximal ends of one of the smaller ones and the distal ends of eight of various sizes. The proximal portion of the smaller metapodial, compared with the median ones, is larger proportionally than in the pes of *H. brachyrhyncus* (?) (Princeton Coll., 11162). The head is thick transversely, triangular in section, conical at the top and larger than the shaft. The shaft, a little below the head, is transversely oval. The distal ends of three of the median metapodials are much like those of *Hyopotamus*, but the dorsal surfaces of the trochlea are not so convex or the groove above so deep, and the trochlea are not bent in toward the plantar side as in *Oreodon* or *Agriochœrus*. The distal ends of two lateral metapodials are symmetrical. They are quite thick and do not appear to have been in close contact with the median ones. There was probably either a hallux or a pollex, as there are two distal ends of very small metapodials.

There are several portions of phalanges and two middle ones nearly complete. The latter are short. The proximal articulating surfaces are slightly concave and separated by a low median convexity. The distal facets have a shallow groove. A lateral ungual is asymmetrical. Its dorso-plantar is greater than its transverse diameter. It has approximately the form and size of one of the median ones of *Oreodon culbertsoni*, but it is shorter and the proximal facet is divided into two unequal areas. One of the median unguals is only a little thicker planto-dorsally, but much broader. The anterior part is gone, but so far as shown the inner margin is nearly straight, while the outer curves inward toward the tip.

Discussion of Relationship of Arretotherium.

Until more complete material of this animal is found, or that of related forms, it would be unwise to form a judgment as to its relationship. We can see resemblances, but these are far from being proof of relationship. There is enough preserved to show that it is very different from any other American genus at least. The skull, so far as preserved, is suggestively similar to that of *Hyopotamus*. The molars, too, aside from the absence of the protoconule, resemble those of *Hyopotamus*. They seem to be much like those of the Indian *Merycopotamus*. The premolars are different from those of *Hyopotamus*. The atlas is not much like anything I know. The lower end of the fibula, the calcaneum, astragalus and cuboid are similar to *Oreodon*. The navicular and the metacarpals and phalanges appear to be more like those of *Hyopotamus*. There is no evidence of relationship to *Agriochœrus*.

Measurements.

	M.
Length of molar-premolar series arranged, without diastema; left side.	.130
Length of incisor (I^{3} ?)	.0074
Width of incisor (I^{3} ?)	.004

	M.
Height of incisor (I^3 ?), crown	.006
Length of canine	.016
Width of canine	.009
Height of canine	.035
Length of P^1	.0092
Width of P^1	.004
Height of P^1	.006
Length of P^2	.0135
Width of P^2, middle	.008
Height of P^2	.011
Length of P^3	017
Width of P^3	.014
Width of P^3, protocone	.0085
Height of P^3	.013
Length of P^4	.016
Width of P^4	.020
Height of P^4	.014
Length of molar series	.072
Length of M^1	.0185
Width of M^1	.020
Length of M^2	.024
Width of M^2	.0255
Length of M^3	.0285
Width of M^3	.0295
Height of M^3	.0190
Length of M^2, right side	.255
Width of M^2, right side	.027
Length of M^3, right side	.029
Width of M^3, right side	.030
Width of foramen magnum, about	.026
Width of occipital condyles, about	.055
Width of neural canal of atlas	.030
Width of anterior cotyles of atlas	.057
Width of odontoid process of axis	.020
Thickness of odontoid process of axis at base	.012
Diameter of distal end of tibia, transverse	.0415
Diameter of distal end of tibia, dorso-plantar	.0235
Diameter of distal end of fibula, transverse	.0103
Diameter of distal end of fibula, dorso-plantar	.0207
Length of tuber of calcaneum above astragalar facet	.043
Diameter of tuber of calcaneum in middle, transverse	.0135
Diameter of tuber of calcaneum in middle, dorso-plantar	.023
Length of astragalus	.0435
Width of astragalus	027
Thickness of astragalus, dorso-plantar	024
Length of cuboid, anterior	.020
Width of cuboid, transverse	.0212
Thickness of cuboid near top	.024

	M
Length of navicular	.021
Width of navicular	.022
Thickness of navicular, dorso pkantar	.0327
Length of ectocuneiform	.012
Width of ectocuneiform	.020
Thickness of ectocuneiform	.014
Width of a median metapodial just above trochlea	.018
Thickness of same	.015

Explanation of Plate IX.

Figs. 1–3. *Arretotherium acridens*, gen. et sp. nov. Natural size. From Blacktail Deer creek.

Fig. 1. Upper teeth of right side. Outer view.

Fig. 2. The same, from below. In Figs. 1 and 2, premolars 3 and 4 are restored from left side. The position and arrangement of the antemolars is conjectural, as they were not found in place.

Fig. 3. Left tarsus with distal extremities of tibia and fibula. Navicular restored from right side.

Fig. 4. *Agriochœrus* (?) *maximus*, sp. nov. Natural size. Molar-premolar series from the right side. From Pipestone creek.

Figs. 5, 6. *Limnenetes platyceps*, gen. et sp. nov. Natural size. From Thompson creek, near Three Forks.

Fig. 7. *Bathegenys alpha*, gen. et sp. nov. Spec. No. 48. Anterior of left mandibular ramus. Natural size. Pipe stone creek.

Fig. 8. *Bathygenys*. Spec. No. 66. Another individual and perhaps a different species from Fig. 7. The last three premolars and the first molar. Natural size.

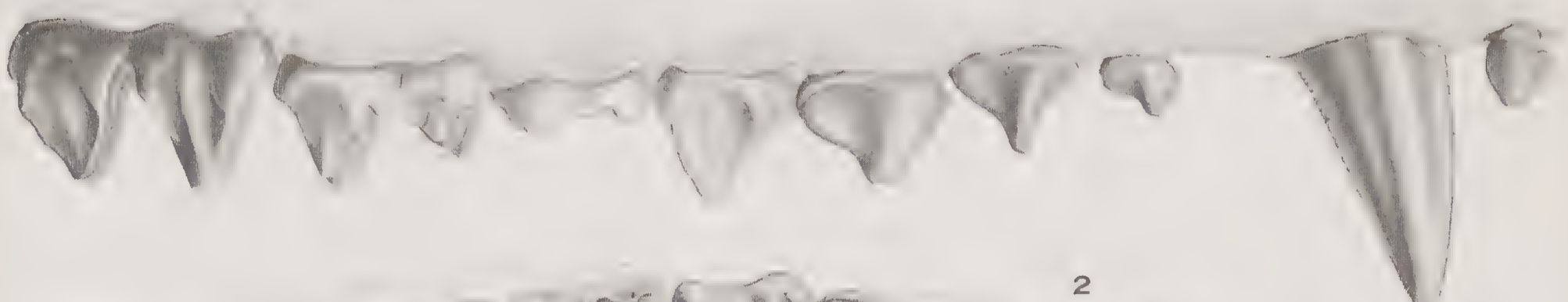
Fig. 8a. The same, with teeth magnified four diameters.

Fig. 9. *Cylindrodon fontis*, gen. et sp. nov. Left mandibular ramus. Natural size. Pipestone creek.

Fig. 9a. The same. Enlarged three diameters.

For "Literature," etc., see page 279.

1



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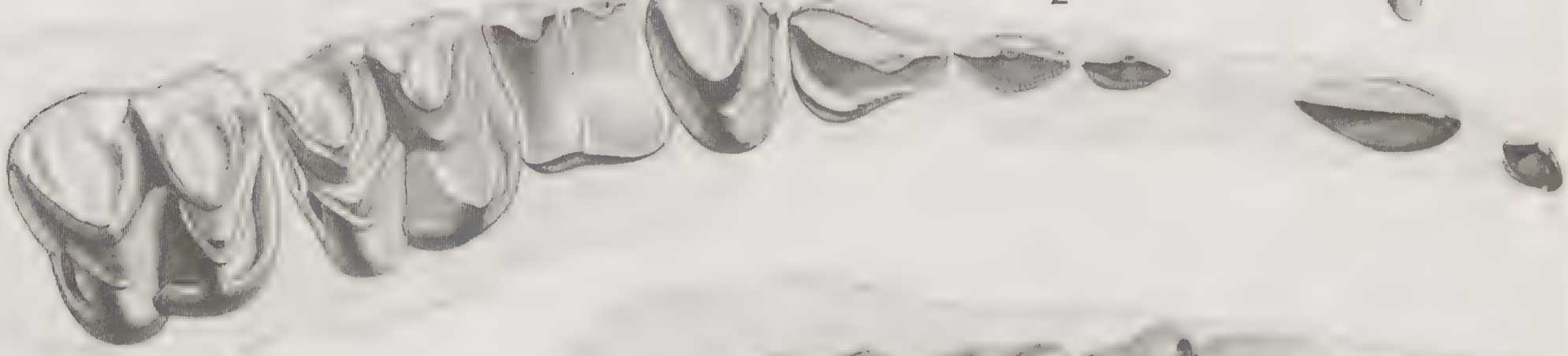

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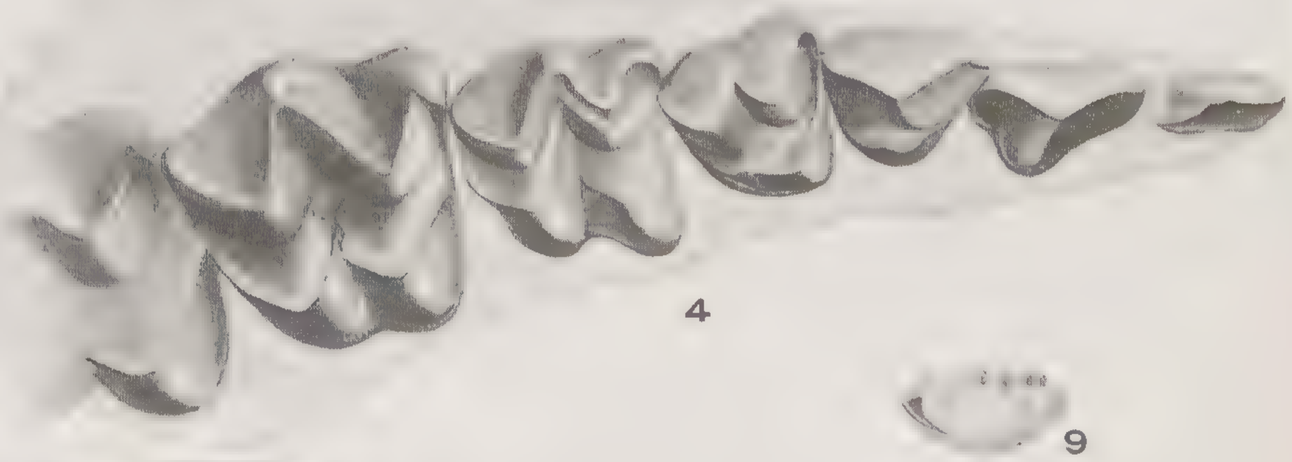
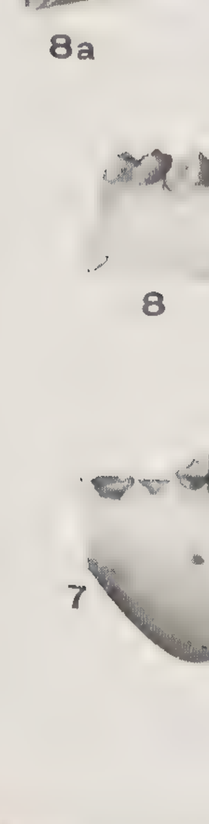


9

5

9a

8a



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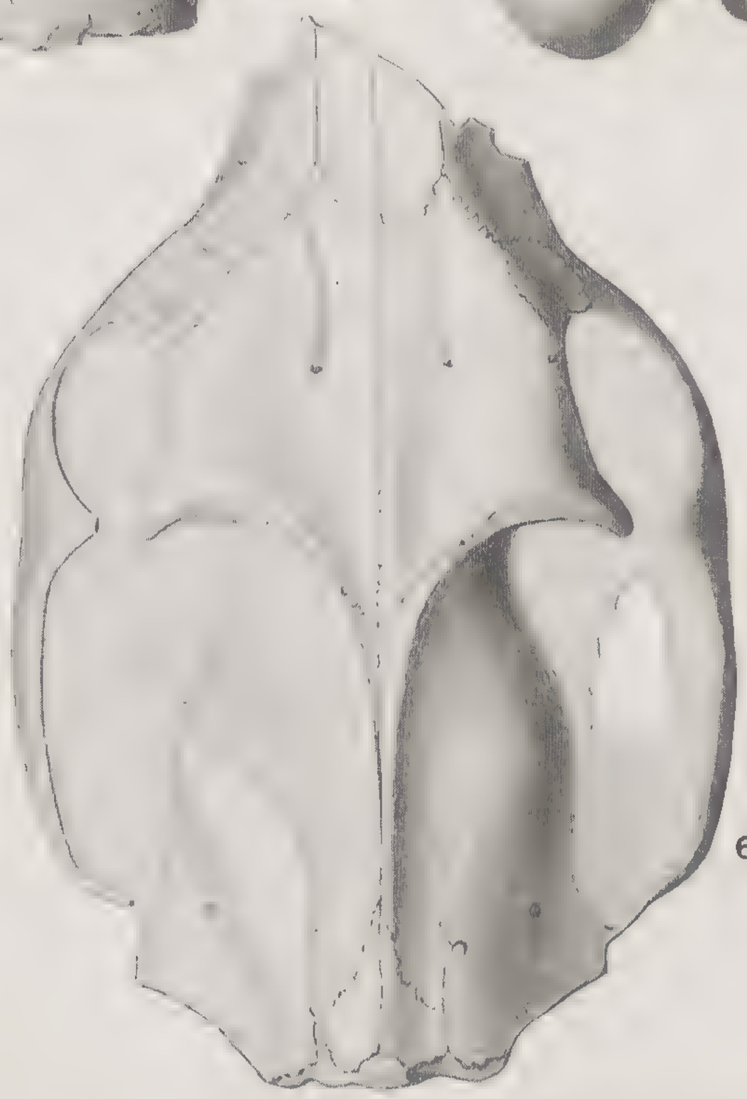

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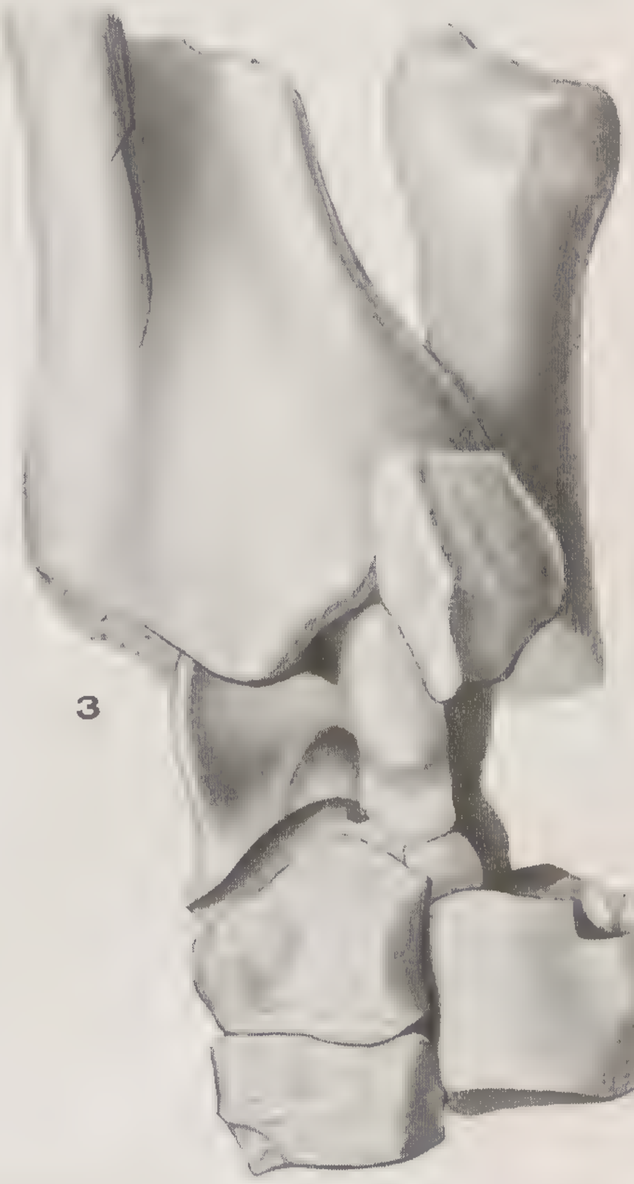

ARRETOTHERIUM, AGRIOCHŒRUS, LIMNENETES, BATHYGENYS AND CYLINDRODON.

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List of Species Described with the Specimen Number.

No. 36. *Ictops acutidens*, sp. nov.

No. 37. *Eumys minor*, sp. nov.

Nos. 38 and 39. *Cylindrodon fontis*, gen. et sp. nov.

No. 40. *Sciurus jeffersoni*, sp. nov.

No. 41. *Steneofiber hesperus*, sp. nov.

No. 42. *Steneofiber complexus*, sp. nov.

Nos. 43, 44 and 45. *Palæolagus temnodon*, sp. nov.

No. 46. *Hyænodon montanus*, sp. nov.

No. 47. *Hyænodon minutus*, sp. nov.

Nos. 48 and 66. *Bathygenys alpha*, gen. et sp. nov.

No. 49. *Limnenetes platyceps*, gen. et sp. nov.

No. 50. *Limnenetes* (?) *anceps*, sp. nov.

No. 56. *Oreodon robustum*, sp. nov.

No. 57. *Eucrotaphus helenæ*, sp. nov.

No. 58. *Agriochœrus maximus*, sp. nov.

No. 59. *Agriochœrus minimus*, sp. nov.

No. 60. *Arretotherium acutidens*, gen. et sp. nov.

No. 62. *Colodon cingulatus*, sp. nov.

No. 63. *Colodon*, sp.

ARTICLE VI.

RESULTS OF OBSERVATION WITH THE ZENITH TELESCOPE OF THE SAYRE OBSERVATORY FROM APRIL 1, 1876, TO DECEMBER 27, 1893.

BY CHARLES L. DOOLITTLE.

Read April 4, 1902.

In presenting for publication the definitive results of the series of Zenith Telescope observations at the Sayre Observatory, mention should be made of the financial assistance rendered by the Trustees of the Gould Fund of the National Academy and by Mr. Robert H. Sayre, the founder of the Observatory. Without this aid the final discussion must have been deferred indefinitely.

Among those who at different times have assisted in the work of computation, I wish particularly to mention Messrs. Henry C. Coffeen, H. J. Woods, Henry B. Evans and Eric Doolittle.

C. L. DOOLITTLE.

In Volume XX, TRANSACTIONS OF THE AMERICAN PHILOSOPHICAL SOCIETY, Article III presents the results of observation with the Zenith Telescope of the Sayre Observatory from January 19, 1894, to August 19, 1895. The brief historical statement there given as to the inception and progress of the investigation does not require repetition.

The present communication consists of three parts, as follows:

I. Investigation of the coordinates of the stars employed in the latitude work at the Sayre Observatory.

II. Results of latitude determination from 1876 to 1891.

III. Results of latitude and aberration from observations extending from October 10, 1892, to December 27, 1893.

I.

The star list is the result of a joint investigation undertaken by Henry B. Evans and myself. Of the 254 stars, 74 are found in the new fundamental catalogue of Newcomb.* The coordinates of the remaining 180 have been deduced from what was practically all material existing at the time of the reduction.

* *Catalogue of Fundamental Stars for 1875 and 1900, reduced to an Absolute System.* Washington, 1898.

In so far as the problem of latitude variation is concerned extremely precise values of the stellar co-ordinates are not required, nor is it important to reduce them to a uniform system. In the present case, however, a preliminary reduction of the observations showed very appreciable changes in the value of the micrometer during the progress of the work. These were probably due to the wearing of the screw as time went on. It is believed that the prejudicial effect of this change has been practically removed by deriving the screw value from the latitude observations, employing intervals sufficiently small to warrant regarding it as constant during the interval.

If the latitude stars could have been selected so that the plus and minus values of the micrometer correction in each group should exactly balance, no harm would follow if small errors of the screw were disregarded. This condition cannot, however, be fully satisfied, at least not for any considerable time, as precession would soon destroy the equilibrium if such existed.

In case this method of treatment is to be free from objection, the Declinations employed must have a high degree of precision. For this reason the matter has received a greater amount of attention than would have been necessary otherwise.

It is hoped, moreover, that the results may prove valuable in lines of investigation other than that which was its immediate object. With this end in view the Right Ascensions have been reduced with the same care and thoroughness as that given to the Declinations. This part of the investigation is the work of Mr. Evans.

The system adopted is that of Auwers, as found in the *Astronomische Nachrichten*, Vol. 134, p. 33. It is not to be understood that this system is considered superior to that of Newcomb; but since Auwers' system has been more commonly employed in this class of investigations, it was thought best to retain it here for the sake of uniformity.

Authorities.

In the list of catalogues employed it is not thought necessary to give more than the names of those which are generally well known. The works themselves should be found in every astronomical library. In case they are not readily accessible, further information regarding them may be obtained from Newcomb's *New Catalogue of Fundamental Stars*, Davis' *Declinations and Proper Motions of Fifty-six Stars*, and Boss' *Declinations of Fixed Stars*.

In case of all catalogues for which Auwers gives systematic corrections, these have been applied. In other cases such corrections have been derived indirectly through the systems of Newcomb or Boss. Where recourse has been had to other methods, mention of the process is found in the accompanying notes. In some of the recent catalogues the uncorrected places have been employed. For the sake of completeness and uniformity,

however, such corrections have been applied in all cases where they were available, although it would seem that any one who has had occasion to examine somewhat closely into this subject, must agree with Newcomb's conclusion that the correction for systematic errors has in recent times been carried too far.

As the Declinations were reduced in advance of the Right Ascensions, a number of catalogues became available for the latter which were not employed for the former. It is also to be observed that the list embraces several catalogues which give one coordinate only. Where the name is followed by the symbol α, the catalogue has been employed only for the Right Ascensions; when followed by the symbol δ, only for the Declinations.

In the explanatory notes s designates the systematic correction in Right Ascension; s' designates the systematic correction in Declination; p designates the weight of the Right Ascension; p' designates the weight of the Declination; t the mean date of observation. The system of weights employed will be spoken of in connection with the method of reduction.

List of Catalogues.

1. Bradley. 1755. Neue Reduction der Bradley'schen Beobachtungen aus den Jahren 1750 bis 1762. Von Arthur Auwers. St. Petersburg, 1888.
2. Mayer. 1755. Tobias Mayer's Sternverzeichniss nach den Beobachtungen auf der Göttinger Sternwarte in den Jahren 1756 bis 1760. Neu bearbeitet von Arthur Auwers. Leipzig, 1894.
3. Fedorenko's Lalande. 1790. Positions Moyenne pour l'Epoque de 1790,0 des Etoiles Circumpolaire, dont les observations ont été publiées par Jérôme de Lalande dans les Mémoires de l'Académie de Paris de 1789 et 1790. Par Ivan Fedorenko. St. Pétersbourg, 1854. $s = \frac{1}{2}$ (Åbo + Bessel's Bradley); p same as 2; t from Histoire Céleste.
4. Lalande. 1800. A Catalogue of those Stars in the Histoire Céleste Française of Jérôme de Lalande for which tables of reduction to the epoch 1800 have been published by Prof. Schumacher. Francis Baily, Esq. This catalogue was used for a few stars where other early authorities were wanting or doubtful. For declinations the places were taken directly from Baily's Catalogue. $p' = 0.1$. For right ascensions Von Asten's tables were used. p same as 2; t from Histoire Céleste.
5. Bossert (a). 1800. Supplément à l'Histoire Céleste de Lalande. Catalogue de 3950 étoiles ramenées à l'équinoxe de 1800. Par M. J. Bossert. Paris, 1892. p same as 2.
6. d'Agelet. 1800. Reduction of the Observations of Fixed Stars made by Joseph Lepaute d'Agelet at Paris in 1783–1785, with a catalogue of the Corresponding Mean Places referred to the equinox of 1800,0. By B. A. Gould. Washington, 1866.

   $s = 0^s.12$.
   $s' =$ Piazzi $- 1''.42$ 0^h to XII^h.
   $s' =$ Piazzi $+ 1''.22$ XII^h to $XXIV^h$.
   p same as 2.
7. Piazzi. 1800. Præcipuarum stellarum inerrantium Positiones Mediæ Ineunte Sæculo xix ex observationibus habitas in Specula Panormitana ab anno 1792 ad annum 1813. Panormi, 1814. t from original observations. Right ascensions of stars north of 65° declination not used.
8. Groombridge. 1810. A Catalogue of Circumpolar Stars deduced from the observations of Stephen Groombridge at Blackheath Observatory. Edited by George Biddell Airy, Esq. London, 1838.

9. Dorpat (*a*). 1814. F. G. W. Struve. Observationes Astronomicas Institutas in Specula Universitatis Cæsareas Dorpatensis, Vol. I.
10. Dorpat (*a*). 1815. Catalogus I.
11. Koenigsberg (*a*). 1815. Bearbeitung von Bessels Beobachtungen am Dollond'schen Mittagsfernrohre in den Jahren 1813–19 Von Dr. Fritz Cohn. Königsberg Beobachtungen, 39 Abtheilung. $s = 0$.
12. Weisse-Bessel (δ). 1825. Bessel's Zone observations reduced by Maximillian Weisse. This was used for a few declinations, usually those for which early determinations were wanting. $p = 0.1$.
13. Schwerd-Oeltzen (*a*). 1828. The positions were taken from Carrington, No. 43.
14. Åbo. 1830. DLX, Stellarum Fixarum Positiones Mediæ ineunte anno 1830 ex observationibus Aboæ habitas deduxit. Fredr. Guil. Aug. Argelander. Helsingforsiæ, 1835. *t* from Davis, Ast. Journal, No. 328.
15. Pearson (δ). 1830. Dr. Pearson's Catalogue of 520 Stars within 6° North and South of the Ecliptic. Memoirs R. A. S., Vol. xv, p. 97. London, 1846. $p' = 0$; 0.1. $s' = 0$.
16. Cambridge. 1830. Airy's First Cambridge Catalogue. Memoirs R. A. S., Vol. xi. London, 1859.
17. Fallows (*a*). 1830. Results of Observations made by the Rev. Fearon Fallows at the Royal Observatory, Cape of Good Hope, in the Years 1829-31. Memoirs R. A. S., Vol. xix, p. 1.
18. Pond. 1830. A Catalogue of 1112 Stars from Observations at Greenwich from 1816 to 1833. London, 1833. *t* was obtained from the original observations in Greenwich Yearly Results.
19. Struve. 1830. Stellarum Fixarum imprimis duplicium et multiplicium pro epocha 1830. Petropoli, 1852.
20. Wrottesley (*a*). 1830. A Catalogue of the Right Ascensions of 1318 Stars. By John Wrottesley, Esq. Memoirs R. A. S., Vol. x.
21. Montojo (*a*). 1835. Mean Positions of the Stars contained in "Mr. Baily's Address" as determined at San Fernando. Memoirs R. A. S., Vol. xii, p. 238.
22. Madras. 1835. A General Catalogue of the Principal Fixed Stars from Observations made at the Honorable East India Company's Observatory at Madras in the years 1830–43. By Thomas Glanville Taylor. Madras, 1844.
23. Rümker. 1836. Mittlere Oerter von 12,000 Fixsternen für den Anfang von 1836, abgeleitet aus den Beobachtungen auf der Hamburger Sternwarte von Carl Rümker. Hamburg, 1852.
24. Köller (*a*). 1838. Extract from a letter from M. Marian Köller, Director of the Observatory at Kremsmünster . . . . accompanying a Catalogue of 208 Stars. Memoirs R. A. S., Vol. xii, p. 373.
25. Armagh. 1840. Places of 5345 Stars observed from 1828 to 1854 at the Armagh Observatory. By Rev. T. R. Robinson. Dublin, 1859.
26. Santini (δ). 1840. A Catalogue of 1677 Stars included between the Equator and Ten Degrees of North Declination, observed at the Royal Observatory of Padua. By Prof. Giovanni Santini. Memoirs R. A. S., Vol. xii, p. 273. $p' = 0$; 0.1; 0.2.
27. Cape of Good Hope. 1840. The Cape Catalogue of Stars deduced from observations made at the Royal Observatory, Cape of Good Hope, 1834 to 1840, and reduced to the epoch 1840 under the superintendence of E. J. Stone. Cape Town, 1878.
28. Gilliss (*a*). 1840. Catalogue of Twelve Hundred and Forty-eight Stars observed at Washington between October, 1838, and July, 1842. Washington, 1846.
29. Greenwich. 1840. Catalogue of 2156 Stars formed from the Observations made from 1836 to 1841 at the Royal Observatory, Greenwich. London, 1849.
30. Oeltzen's Argelander (*a*). 1842. Annalen der K. K. Sternwarte in Wien. Bd. i. Wien, 1851. *s* same as Åbo; *p* same as Rümker; *t* from original zones.
31. Greenwich. 1845. Catalogue from observations from 1842 to 1847.
32. Paris. 1845. Catalogue de l'Observatoire de Paris. Étoiles observées aux Instruments Méridiens de 1837 à 1853.
33. Poulkova (*a*). 1845. Étoiles observées occasionnellement. St. Pétersbourg, 1875.
34. Radcliffe. 1845. The Radcliffe Catalogue of 6317 Stars chiefly Circumpolar reduced to the Epoch 1845. Formed from the Observations made at the Radcliffe Observatory under the Superintendence of Manuel John Johnson. Oxford, 1860.

35. Oudemans (δ). 1849. Dissertatio Astronomica Inauguralis exhibens Observationes ope Instrumenti Transitarii partabilis institutas. . . . . Lugdini Batavorum, 1852.

36. Cape of Good Hope. 1850. Catalogue of 1710 Stars for the Epoch 1850, from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1849 to 1852, under the Direction of Sir Thomas Maclear.

37. Gilliss. 1850. A Catalogue of 1963 Stars and of 290 Double Stars observed by the U. S. Naval Astronomers during the Expedition to the Southern Hemisphere. Appendix i to Washington Yearly Observations for 1868.

38. Greenwich. 1850. Catalogue of 1576 Stars formed from Observations made during Six Years, from 1848 to 1853, at the Royal Observatory, Greenwich.

39. Madras. 1850. A Subsidiary Catalogue of 1440 Stars selected from the British Association Catalogue, reduced to Jan. 1, 1850, from Observations made at Madras in the Years 1849–53. Madras, 1854.

40. Rümker. 1850. Neue Folge der mittleren Oerter von Fixsternen für den Anfang von 1850, abgeleitet aus den Beobachtungen auf der Hamburger Sternwarte von Carl Rümker. Hamburg, 1852–59.

41. Sonntag(a). 1850. Mittlere Oerter für 1850 von Vergleichsternen zum Cometen I 1850. Ast. Nach., Bd. xxxiv. p same as 32 ; s = .050.

42. Wrottesley (a). 1850. A Catalogue of the Right Ascensions of 1009 Stars contained in the Catalogue of the British Association for the Advancement of Science. . . . . By Lord Wrottesley. Memoirs R. A. S., Vol. xxiii.

43. Carrington. 1855. A Catalogue of 3735 Circumpolar Stars observed at Redhill in the years 1854, '55 and '56 and reduced to the Mean Position for 1855. By Richard Christopher Carrington. p same as 13.

44. Madras. 1855. A Catalogue of 317 Stars . . . . deduced from Observations at Madras. Memoirs R. A. S., Vol. xxii.

45. Moesta. 1855. Observaciones Astronómicas hechas en el Observatorio Nacional de Santiago de Chile en los Años de 1853, 1854 y 1855. Vol. i. Santiago, 1859.

46. Moscow. 1855. Catalogue des étoiles observées par M. Drachoussoff. Annales de l'Observatoire de Moscow, Vol. vi. s same as Nautical Almanac ; p same as 53.

47. Poulkova. 1855. Positions Moyenne déluites des observations faites au cercle méridien 1840–1869 et réduites à l'époque 1855, 0. Observations de Poulkova, Vol. viii. St. Pétersbourg, 1889.

48. Cape of Good Hope. 1860. The Cape Catalogue of 1159 Stars, deduced from Observations by Sir Thomas Maclear at the Royal Observatory, Cape of Good Hope, 1856 to 1861. Cape Town, 1893.

49. Santini (δ). 1860. Posizioni Medie di 1,425 Stelle, dedotte dal osservazioni fatte dal defunto Prof. Trettenero 1861-65. Venezia, 1870. p' = 0 ; 0.1 ; 0.2.

50. Greenwich. 1860. Seven Year Catalogue of 2022 Stars deduced from Observations extending from 1854 to 1860 at the Royal Observatory, Greenwich.

51. Moscow. 1860. Resultate aus der Zonen-Beobachtungen am Meridian Kreise der Moskauer Sternwarte während der Jahre 1858-69. I Zone 0 –4 . Memoirés de l'Académie Impériale des Sciences de St. Pétersbourg, viii Série : Classe Physico-Mathematique, Vol. I, No. 5. s same as Poulkova, 1855 ; p same as 53.

52. Paris. 1860. Catalogue de l'Observatoire de Paris. Etoiles observée de 1854 à 1867.

53. Radcliffe. 1860. Second Radcliffe Catalogue, containing 2386 Stars deduced from observations extending from 1854 to 1861 . . . . Oxford, 1870.

54. Yarnall. 1860. Catalogue of Stars observed at the United States Naval Observatory during the years 1845 to 1877. Third edition revised. . . . . Washington, 1889.

55. Poulkova (δ). 1862. Observations faites à l'Instrument des passages établi dans le Premier Vertical. Oom. Observations de Poulkova, Vol. iii, pp. 223–238.

56. Greenwich. 1864. New Seven Year Catalogue of 2760 Stars, deduced from Observations extending from 1861 to 1867 at the Royal Observatory, Greenwich.

57. Brussels. 1865. Catalogue de 10,792 Étoiles observée à l'Observatoire Royal de Bruxelles de 1857 à 1878 . . . . Par Ernest Quetelet, Bruxelles, 1887.

58. Poulkova (a). 1865. Ascensions droites Moyenne des étoiles occasionnellement observées pour 1865,0. Observations de Poulkova, Vol. xii.

59. Schjellerup(a). 1865. Stjernefortegnelse indeholdende 10,000 Positioner af Teleskopiske Fixstjerner imellem — 15 og + 15 Gradus Deklination. Kjøbenhavn, 1864. s same as Nautical Almanac interpolated as follows : $s = 1860 + \frac{7}{15}$ (1875–1860) ; p same as 53.

60. Glasgow. 1870. Catalogue of 6415 Stars for the Epoch 1870, deduced from Observations made at the Glasgow University Observatory during the Years 1860 to 1881 . . . . By Robert Grant. Glasgow, 1883.

61. Melbourne. 1870. First Melbourne General Catalogue of 1227 Stars for the Epoch 1870 deduced from Observations extending from 1863 to 1870, made at the Melbourne Observatory. Melbourne, 1874.

62. Greenwich. 1872. Nine Year Catalogue of 2263 Stars deduced from Observations extending from 1868 to 1876, made at the Royal Observatory, Greenwich.

63. Astronomische Gesellschaft Zones. 1875. These include all of this series of catalogues published, together with the places of those stars found in the Leyden, Lund and Dorpat Zones, those of the earlier and later Lund Zones being combined separately. p is taken the same as Paris, '75 ; $p' = 1.$ throughout the series.

64. Armagh. 1875. Second Armagh Catalogue of 3300 Stars for the Epoch 1875, deduced from Observations made at the Armagh Observatory during the Years 1859 to 1883. . . . . Dublin, 1886. p same as 60.

65. Becker. 1875. Resultate aus Beobachtungen von 521 Bradley'schen Sternen am grossen Berliner Meridiankreise von Dr. E. Becker. Berlin, 1881.

66. Cordoba. 1875. Catálogo General Argentino. Cordoba, 1886.

67. Dunsink. 1875. Mean Places of 321 Red Stars deduced from Observations made with the Meridian Circle at Dunsink. . . Dublin, 1882. $s = 0$; p same as Paris, '75.

68. Washington. 1875. The Second Washington Catalogue of Stars . . . . prepared under the Direction of J. R. Eastman.

s obtained through Newcomb's system.

$s' =$	$-0''.33$	from $\delta =$ 0	to $\delta = 40°$
$=$	.00	40°	50°
$= +$	.09	50°	90°

69. Göttingen. 1875. Mittlere Oerter der in der Zonen — 0° und — 1° der Bonner Durchmusterung enthaltenen Sterne. . . . Göttingen, 1869. s same as for Nautical Almanac as follows : $s = s_{1860} + \frac{8}{15}(s_{1875} - s_{1860})$; p same as Glasgow, '70.

70. Harvard. 1875. Catalogue of Primary and Secondary Stars observed during the years 1870–1879 with the Meridian Circle of the Harvard College Observatory. Cambridge, 1886.

71. Paris. 1875. Catalogue de l'Observatoire de Paris. Étoiles observée de 1868 à 1881.

72. Poulkova. 1875. Catalog von 5634 Sternen für die Epoche 1875.0 aus den Beobachtungen am Pulkowaer Meridiankreise während der Jahre 1874–1880 von H. Romberg. St. Pétersbourg, 1891.

73. Stockholm. 1875. Results of meridian observations found in the first five volumes of the publications of the Stockholm Observatory. p same as Paris, '75.

74. Respighi (δ). 1875. Catalogo delle Declinazione Medie pel 1875.0 di 1463 Stelle comprese fra i paralleli 20° e 64° nord. . . . . Roma, 1880.

75. Cape of Good Hope. 1880. Catalogue of 12,441 Stars for the Epoch 1880 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1871 to 1879. By Edward J. Stone. London, 1881.

76. Greenwich. 1880. Ten Year Catalogue of 4059 Stars, deduced from Observations extending from 1877 to 1886 at the Royal Observatory, Greenwich.

77. Melbourne. 1880. Second Melbourne General Catalogue of 1211 Stars for the Epoch 1880, deduced from Observations extending from 1871 to 1884, made at the Melbourne Observatory. Melbourne, 1889.

78. Respighi (δ). 1880. Catalogo delle Declinazione Medie pel 1880,0 di 1004 Stelle di 1ª in 6ª grandezza comprese fra 0° e 20° nord, e 64° e 90° nord. . . . . Roma, 1885.

79. Munich (a). 1880. Erster Münchener Sternverzeichniss erhaltend die Mittleren Oerter von 33,083 Sternen. Müuchen, Neue Annalen, Bd. i. p same as 60.

80. De Ball (δ). 1880. Declinationen von 200 Sternen innerhalb der Zone + 49° bis 51°, nach Beobachtungen im ersten Vertical am Passagen-instrumente der Herzoglichen Sternwarte zu Gotha. Ast. Nach., Bd. ci, 353.

81. Cape of Good Hope. 1885. Catalogue of 1713 Stars for the Equinox 1885,0 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1879 to 1885.

82. Harzer. 1885. Resultate aus Beobachtungen am Meridiankreise der Herzoglichen Sternwarte zu Gotha. Ast. Nach., Bd. cxxvii, 170. $s = 0$; $p = \frac{1}{2}$ that of 76.

83. Kasan (δ). 1885. Les Observations faites à l'instrument des passages établi dans le premier vertical. Kasan Observations for 1893.

84. Karlsruhe. 1885. Lists found in the first four volumes of the publications of the observatory. $s = 0$; p same as Radcliffe, '60.

85. Washburn (δ) '84, '85. 1885. Publications of the Washburn Observatory, Vol. iv.

86. Safford (a). 1885. The Williams College Catalogue of North Polar Stars. Williamstown, Mass., 1888.

87. Nyrén (δ). 1887. Declinationsbestimmungen einiger Helleren Sterne zwischen + 18° und + 26° am Pulkowaer Verticalkreise. A. N., No. 2904, Bd. 121.

88. Cape of Good Hope. 1890. A Catalogue of 3007 Stars for the Equinox 1890 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1885 to 1895.

89. Cincinnati. 1890. A Catalogue of 2000 Stars for the Epoch 1890. Publications of the Cincinnati Observatory, No. 13. p same as Paris 75.

90. Dunsink. 1890. Mean places of 717 Stars deduced from Observations made with the Meridian Circle at Dunsink. Dublin, 1896. $s = 0$; p same as 71.

91. Glasgow. 1890. Second Glasgow Catalogue of 2156 Stars for the Epoch 1890 deduced from Observations made at the Glasgow University Observatory during the Years 1886 to 1892. Glasgow, 1892.

92. Küstner. 1890. Veröffentlichung der Königlichen Sternwarte zu Bonn, No. 2. $s = 0$.

93. Radcliffe. 1890. Catalogue of 6424 Stars for the Epoch 1890. Formed from Observations made at the Radcliffe Observatory, Oxford, during the Years 1880–1893.

94. Battermann. 1895. Resulte aus Beobachtungen von 379 Anhaltsternen und 1640 durch Anschluss bestimmten Sternen, angestellt in den Jahren 1892–1897 am Grossen Berliner Meridiankreise von Dr. H. Battermann. Berlin, 1899. $s = 0$.

95. Cincinnati. 1895. Catalogue of 2030 Stars for the Epoch 1895. Publications of the Cincinnati Observatory, No. 14. $s = 0$; p same as 71.

96. Tucker (a). 1895. Meridian Circle Observations of 310 Standard Stars. Publications of the Lick Observatory, Vol. iv. Sacramento, 1900.

97. Tucker (δ). 1897. The entire list of stars was very carefully observed by R. H. Tucker, of the Lick Observatory, in the years 1896 and 1897. It was intended to publish the results of these observations in full in this connection, but the preparation of this work has been so long delayed that it now appears superfluous, in view of the fact that a much more detailed report than could be given here will appear in a forthcoming publication of the Lick Observatory. The following note is by Mr. Tucker:

> "Each star was observed twice in each position of the instrument, fixed circle East and West, and "the greater part of the stars above 70° were similarly observed at both culminations.
>
> "The places were reduced with the Declinations from the catalogue of Louis Boss, *Declinations of "Fixed Stars, U. S. Northern Boundary Commission*, 1879.
>
> "The probable error of a single observation is ± 0″.18. The probable error of observation for the "mean of four, in the two positions is ± 0″.12, including the effect of graduation error."
>
> The reduction to Auwers' system has been applied and the results have been employed with a uniform weight of 3.

98. Wirtz (δ). 1900. Bestimmung der Deklinationen von 487 Sternen und der Polhöhe der Bonner Sternwarte aus Beobachtungen . . . . im Ersten Vertical. Veröffentlichung der Königlichen Sternwarte zu Bonn, No. 3.

99. Dunsink. 1900. Mean Places of 1101 Stars deduced from Observations made with the Meridian Circle at Dunsink. Dublin, 1899. *p* same as Paris, '75.

100. Küstner (*a*). 1900. Veröffentlichung der Königlichen Sternwarte zu Bonn, No. 4.

Yearly Series.

101. 1835–1869. Edinburgh. Astronomical Observations at the Royal Observatory, Edinburgh.

102. 1836–1869. Cambridge. Astronomical Observations made at the Observatory of Cambridge.

103. 1862–1876. Radcliffe. Results of Astronomical Observations made at the Radcliffe Observatory.

104. 1862–1887. Madras. Meridian Circle Observations.

105. 1879–1882 (*a*). Brussels. Annales de l'Observatoire Royal de Brusselles, Nouvelle Series. *s* same as Nautical Almanac; *p* same as 57.

106. 1887–1896. Greenwich. Annual volumes.

Method of Reduction.

Approximate positions for 1875 were obtained from whatever source was available. Many of these were the result of a previous reduction, and with very few exceptions the assumed places differed from the final values only by fractions of a second. The assumed proper motions were in part the result of a previous reduction, others were taken from Auwers' Bradley and other sources.

These assumed coordinates were then reduced to the epoch of the various catalogues in which the star was found, using for this purpose the formula

$$a = a_{1875} + \left[\frac{da}{dt}\right](\tau - 1875) + \tfrac{1}{2}\left[\frac{d^2a}{dt^2}\right](\tau - 1875)^2 + \tfrac{1}{6}\left[\frac{d^3a}{dt^3}\right](\tau - 1875)^3$$

α being the Right Ascension or Declination of any star.

τ the epoch of the catalogue.

The formulæ for the differential coefficients for the epoch 1875, using the constants of Struve and Peters, are as follows, in which

α = the Right Ascension.

δ = the Declination.

μ = the Proper Motion in Right Ascension.

μ' = the Proper Motion in Declination.

$$\frac{da}{dt} = 3.^s07225 + [0.126115] \sin\alpha \tan\delta + \mu.$$

$$\frac{d\delta}{dt} = [1.302206] \cos\alpha + \mu'.$$

$$\frac{d\mu}{dt} = [5.988]\, \mu \cos\alpha \tan\delta + [4.812]\, \mu' \sin\alpha \sec^2\delta + [4.99]\, \mu\, \mu' \tan\delta.$$

$$\frac{d^2a}{dt^2} = [4.63380_n]\left(\frac{da}{dt} - \mu\right) + [5.98778]\left(\frac{da}{dt} + \mu\right)\cos\alpha \tan\delta + [4.81169]\left(\frac{d\delta}{dt} + \mu'\right)\sin\alpha \sec^2\delta + [4.9866]\, \mu\, \mu' \tan\delta + 0.^s000\,032\,210.$$

$$\frac{d^2\delta}{dt^2} = [4.63380_n]\left(\frac{d\delta}{dt} - \mu'\right) + [7.16387_n]\left(\frac{da}{dt} + \mu\right)\sin\alpha + [6.7367_n]\, \mu^2 \sin 2\delta.$$

$$\frac{d^3\delta}{dt^2} = [2.0987]\left(\frac{da}{dt} + \frac{\mu}{2}\right)\sin\alpha + [7.1639_n]\left(\frac{d^2a}{dt^2} + \frac{d\mu}{dt}\right)\sin\alpha + [3.0255_n]\left(\frac{da}{dt} + \mu\right)\frac{da}{dt}\cos\alpha.$$

The numbers enclosed in brackets are logarithms.

For $\frac{d^3a}{dt^3}$ the Right Ascension and Declination were reduced to 1825 and 1925, using for this purpose the first and second differential coefficients already computed. $\frac{d^2a}{dt^2}$ was then derived for these dates, the differences giving $\frac{d^3a}{dt^3}$ with all necessary precision. For checking these values the tables given by Gould* were employed from 0^h to 12^h, neglecting proper motion. From 12^h to 24^h the tables of Oppolzer† were similarly used.

As already stated the catalogue places were reduced to Auwers' system whenever the necessary corrections were available. A correction for proper motion was also applied in all cases where the necessary data could be found.

Let τ be the epoch of the catalogue,

t the mean date of observation, usually different from τ,

μ'' the proper motion employed in forming the catalogue,

μ the proper motion assumed in this discussion,

The correction will be $(\tau - t)\ (\mu - \mu'') = \delta_\mu \alpha$.

It is perhaps superfluous to state that both t and μ'' are unknown in case of many of the older catalogues.

Let n be the difference between the corrected catalogue place and the assumed place, reduced as above explained to the epoch of the catalogue,

Then each catalogue furnishes an equation of the form

$$\sqrt{p}\,(\Delta\alpha + T\Delta\mu = mn)$$

In which p is the weight of the catalogue place,

$\Delta\alpha$ the correction to the assumed Declination, or Right Ascension,

$\Delta\mu$ the correction to the assumed proper motion,

$T = 1875 - t$.

A least square solution gives the most probable values of $\Delta\alpha$ and $\Delta\mu$.

The method of solving the equations is one very commonly employed in cases like this and is as follows:

Let t_0 be the weighted mean of the catalogue epochs, or of the epoch of observation when this differs from that of the catalogue,

$t_1,\quad t_2 \qquad t_n$ the epochs of the respective catalogues,

$T_1,\quad T_2 \qquad T_n = (t_1 - t_0),\quad (t_2 - t_0) \qquad (t_n - t_0)$

ΣpT should be zero.

* *Catálogo de Las Zonas Estelares,* Appendix, Table iv, Cordoba, 1884. In using this table it must be remembered that the value of p^3 as given in column four should be doubled. See *Ast. Nach.*, Bd. 137, p. 295.

† *Lehrbuch zur Bahnbestimmung der Kometen und Planeten,* Vol. i, Table XII.

Then we have

$$\Delta\alpha = \frac{\Sigma pn}{\Sigma p} \qquad \Delta\mu = \frac{\Sigma pTn}{\Sigma pT^2}$$

Check $\Sigma pvv = \Sigma pnn - (\Sigma pn)\,\Delta\alpha - (\Sigma pTn)\,\Delta\mu$

$\Delta\alpha$ for 1875 will be the above $\Delta\alpha + (1875 - t_0)\,\Delta\mu$.

An example follows which will illustrate the various steps in the process:

Star. B A C 3140

Assumed Coordinates and proper motion for 1875.0.

$\alpha = 9^h\ 7^m\ 10^s.87 \quad \mu = +.0056$

$\delta = 54^\circ\ 32'\ 11''.15 \quad \mu' = +.068$

	Catalogue.	τ	t	*No. Obs.*	μ''	n	p	pt	pn	T	pT	pTn	pT^2	v
1	Bradley	1755	54.2	3	+.0056	—0.009	.3	—13.74	—0.0027	—103.22	—30.97	+0.2790	+3199.20	—0.063
2	Piazzi	1800	04.83	9		+0.261	.08	+ 0.39	+0.0209	— 52.59	— 4.21	—1.0962	220.92	—0.300
3	Groombridge	1810	08.8	6		—0.244	.2	1.76	—0.0488	— 48.62	— 9.72	+2.3668	471.42	+0.208
4	Dorpat	1814	14.11	2		—0.212	.2	2.82	—0.0424	— 43.31	— 8.66	+1.8444	376.71	+0.179
5	Pond	1830	31.54	13		+0.070	.4	12.62	+0.0280	— 25.88	—10.35	—0.7280	269.36	—0.091
6	Madras	1835		11		+0.042	.3	10.50	+0.0126	— 22.42	— 6.73	—0.2814	150.08	—0.061
7	Rümker	1836		6		—0.040	.2	7.20	—0.0080	— 21.42	— 4.28	+0.1720	92.02	+0.022
8	Armagh	1840	34.74	2		+0.006	.1	3.47	+0.0006	— 22.68	— 2.27	—0.0138	52.21	—0.025
9	Gilliss	1840	41.85	1	+.011	—0.010	.05	2.09	—0.0005	— 15.57	— 0.78	+0.0080	12.48	—0.005
10	Edinburgh	1842	42.18	5		+0.225	.5	21.09	+0.1125	— 15.24	— 7.62	—1.7100	115.52	—0.239
11	Oeltzen's Arg'er	1842	42.12	1		—0.118	.05	2.11	—0.0059	— 15.30	— 0.77	+0.0944	12.24	+0.104
12	Greenwich	1845	44.87	6	+.011	—0.186	.7	31.41	—0.1302	— 12.55	— 8.79	+1.6368	110.88	+0.173
13	Radcliffe	1845	47.9	7	+.004	+0.103	.9	43.11	+0.0927	— 9.52	— 8.57	—0.8858	81.70	—0.114
14	Paris	1845	41.6	18		—0.043	1.1	45.76	—0.0473	— 15.82	—17.40	+0.7482	274.92	+0.028
15	Poulkova	1855	47.80	5	+.0056	—0.086	1.0	47.80	—0.0860	— 9.62	— 9.62	+0.8256	92.16	+0.075
16	Greenwich	1860	59.5	3	+.004	—0.013	.9	53.55	—0.0117	+ 2.08	+ 1.87	—0.0247	3.99	+0.010
17	Radcliffe	1860	59.2	4	+.004	—0.003	.4	23.68	—0.0012	+ 1.78	+ 0.71	—0.0021	1.26	.000
18	Yarnall	1860	72.5	4		—0.112	.7	50.75	—0.0784	+ 15.08	+10.56	—1.1872	160.06	+0.117
19	Brussells	1865	66.00	4		+0.032	1.1	72.60	+0.0352	+ 8.58	+ 9.44	+0.3008	80.84	—0.031
20	A. G. Zones	1875	75.2	2		—0.131	.3	22.56	—0.0393	+ 17.78	+ 5.33	—0.6943	94.34	+0.138
21	Paris	1875	81.2	2		+0.039	.3	24.36	+0.0117	+ 23.78	+ 7.13	+0.2769	168.98	—0.028
22	Stockholm	1875	75.53	3		—0.130	.4	30.21	—0.0520	+ 18.11	+ 7.24	—0.9360	130.32	+0.137
23	Madras	1878.40	78.61	5		+0.098	.5	39.31	+0.0490	+ 21.19	+10.60	+1.0388	224.72	—0.089
24	Greenwich	1880	84.24	7	+.0056	+0.045	2.9	+244.30	+0.1305	+ 26.82	+77.78	+3.5010	2085.04	—0.032
							13.58 Σp	779.71 Σpt	—0.0607 Σpn		— 0.08 ΣpT	+5.5322 ΣpTn	+8481.37 ΣpT^2	

$$t_0 = \frac{779.71}{13.58} = 57.42$$

Weighed mean date = 1857.42

$$\Delta\alpha = \frac{-0.0607}{13.58} = -0.^s0045$$

$$\Delta\mu = \frac{5.5322}{8481.37} = +0.^s00065$$

$$\Delta\alpha_{1875} = -0.0045 + \big(0.00065 \times (1875 - 1857.42)\big) = +0.0069$$

Assumed α	9^h	7^m $10^s.87$
Final value	9^h	7^m $10^s.877$
Assumed μ	$+0.^s0056$	
Final value	$+0.^s00625$	

Σpv^2	0.1277
Σpn^2	0.1315
$-(\Sigma pn)\ \Delta\alpha$	$= -0.0003$
$-(\Sigma pT^2)\ \Delta\mu$	$= -0.0036$
Check	0.1276

	Catalogue.	τ	t	No Obs.	μ''	n	p	pt	pn	T	pT	pT^2	pTn	v
1	Bradley	1755	52.2	6	+.068	+ 0.03	.6	— 28.7	+ .018	—1.05	— .630	+ .662	— .019	— .28
2	Piazzi	1800	04.9	7		+ 0.24	.3	+ 1.5	+ .072	— .53	— .159	.084	— .038	+ .10
3	Lalande	1800				+1.77	.0	+ 0.0	— .000	— .58	— .000	.000	— .000	+1.62
4	Groombridge	1810	09.5	6		—0.82	.6	+ 5.7	— .492	— .48	— .288	.138	+ .236	— .94
5	Pond	1830	31.9	20		—0.13	1.0	+ 31.9	— .130	— .26	— .260	.068	+ .034	— .17
6	Taylor	1835		11	+.02	—0.51	.5	+ 17.5	— .255	— .22	— .110	.024	+ .056	— .54
7	Rümker	1836		6		+1.30	.5	+ 18.0	+ .650	— 21	— .105	.022	— .136	+1.27
8	Edinburgh	1840	40.2	3		—0.02	.3	+ 12.1	— .006	— .17	— .051	.009	+ .001	—0.03
9	Armagh	1840	52.2	5		—0.48	.5	+ 26.1	— .240	— .05	— .025	.001	+ .012	— .46
10	Greenwich	1840	40.0	21		+ 0.66	3.0	+ 120.0	+ 1.980	— .18	— .540	.097	— .356	+ .64
11	O' Argelander	1842				+0.26	.0	+ 00.0	— .000	— .16	— .000	.000	— .000	+ .25
12	Greenwich	1845	44.0	32	+.02	+0.24	3.0	+ 132.0	+ .720	— .14	— .420	.059	— .101	+ .24
13	Radcliffe	1845	46.8	13	+.06	—0.87	2.0	+ 93.6	—1.740	— .11	— .220	.024	+ .191	— .86
14	Paris	1845	39.5	6		+0.41	2.0	+ 79.0	+ .820	— .18	— .360	.065	— .148	+ .39
15	Poulkova	1855	47.8	5	+.068	—0.55	2.0	+ 95.6	—1.100	— .10	— .200	.020	+ .110	— .54
16	Greenwich	1860	59.5	3	+ .06	+ 0.05	1.0	+ 59.5	+ .050	+ .02	+ .020	.000	+ .001	+ .10
17	Yarnall	1860	59.7	8		+ 0.48	1.5	+ 89.6	+ .720	+ .02	+ .030	.001	+ .014	+ .53
18	Paris	1860	63.8	13		—0.81	2.0	+ 127.6	—1.620	+ .06	+ .120	.007	— .097	— .75
19	Brussels	1865	66.2	4		+ 0.45	1.0	+ 66.2	+ .450	+ .09	+ .090	.008	+ .040	+ .53
20	Ast. Gesellschaft	1875	75.2	2		—0.26	1.0	+ 75.2	— .260	+ .18	+ .180	.032	— .047	— .15
21	Paris	1875	81.2	2		—0.11	1.0	+ 81.2	— .110	+ .24	+ .240	.058	— .026	+ .02
22	Respighi	1875	76.1	22		0.12	1.5	+ 114.2	— .180	+ .19	+ .285	.054	— .034	— .01
23	Stockholm	1875	75.2	1		—0.26	.3	+ 22.6	— .078	+ .18	+ .054	.010	— .014	— .16
24	Madras	1878.4	78.6	5		+0.79	1.5	+ 117.9	+1.185	+ .21	+ .315	.066	+ .249	+ .91
25	Greenwich	1880	81.0	7	+.068	—0.21	2.0	+ 168.0	— .420	+ .26	+ .520	.135	— .109	— .08
26	Kasan	1885		3	+.068	—0.23	1.0	+ 85.0	— .230	+ .28	+ .280	.078	— .064	— .09
27	Tucker	1897	97.0	4		—0.42	3.0	+291.0	—1.260	+ .40	+ 1.200	.480	— .504	— .24
							33.1 Σp	1902.3 Σpt	—1.456 Σpn		— .034 ΣpT	+2.202 ΣpT^2	—0.749 ΣpTn	

$$t_0 = \frac{1902.3}{33.1} = 57.5$$

Weighted mean date 1857.5

$$\Delta\delta = -\frac{1.456}{33.1} = -0''.044$$

$$\Delta\mu' = -\frac{0.749}{2.202} = -0''.340$$

Σpv^2	+ 8.74
Σpn^2	+ 9.05
$-(\Sigma pn)\ \Delta\delta$	— .06
$-(\Sigma ptu)\ \Delta\mu'$	— .25
Check	8.74

$\Delta\mu'$ is here the correction to the centennial proper motion.

$$\Delta\delta_{1875} = -0''.044 - \big(.0034 \times (1875 - 1857.5)\big) = -0''.104$$

Assumed δ	54°	32′	11″.15
Final value	54°	32′	11″.05

Assumed $\mu' = +0.068$

Final value + 0.0646

Weights.

In case of the Right Ascensions the weights have been taken from Auwers' values, *Astronomische Nachrichten*, Bd. 151, for all authorities found there. For other cases the attempt has been made to conform as closely to this system as practicable.

For the Declinations the system of weights is nearly the same as that given by Davis.* The most noticeable differences between the weights here employed and those of Newcomb are, first, the greater value assigned by Newcomb to the Poulkova and Washington catalogues; and second, in general the greater increase in weight corresponding to an increase in the number of observations. This last feature is not usually very conspicuous in the present discussion, as there are comparatively few cases where the number of observations is large. For the purpose of comparison the weights assigned by Newcomb to the authorities employed in the above example are given below, together with such as are given by Boss† in connection with his investigation.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Wght. here used	.6	.3	.0	.6	1.0	.5	.5	.3	.5	3.0	.0	3.0	2.0	2.0	2.0	1.0	1.5	2.0	1.0	1.0	1.0	1.5	.3	1.5	2.0	1.0	3.0
Newcomb	.5			.4	1.0					3.0		1.0			5.0	1.5	2.5								2.5		2.0
Boss		.1		.3	.8	.2		.6	.3	1.5		2.5	.6	1.0	3.0	1.0	.7	3.0	1.5								

This comparison will illustrate the different conclusions which have been reached as to the relative merits of some of the authorities. It is not claimed that the weights here employed are in all cases the best, but the effort has been made to follow a consistent system throughout in order to reach results which shall be so far as possible homogeneous.

The Star List.

The list of 254 latitude stars which follows includes 74 which are found in Newcomb's new Fundamental Catalogue. The places of these have been taken directly from that publication, applying the reduction to Auwers' system as explained below. Polaris is an exception, the position being taken without change from Newcomb. There are also three stars given in Davis' paper before referred to.—*The Declinations and Proper Motions of Fifty-six Stars*—the declinations of these have been taken from that publication.

The coordinates of the remaining stars—180 right ascensions and 177 declinations—have been derived as explained in the preceding pages.

As Newcomb's system is no doubt preferable to that of Auwers' for the reason that

* *Declinations and Proper Motions of Fifty-six Stars*, pages 14–18.

† *Declinations of the Fixed Stars, Report of the U. S. Northern Boundary Commission*, Appendix ii.

it represents more closely the actual state of the celestial sphere, it is very desirable that we should be able to refer our coordinates to that system. This may be very readily done by employing the formulæ and tables given by Newcomb for passing from one system to the other. These are reproduced here for the convenience of any wishing to make the change. The reduction of the declinations to the system of Boss is also included.

In what follows N refers to the system of Newcomb,

A refers to that of Auwers.

On page 156 of Newcomb's memoir is given for the difference of the Equinoxes

$$\mathrm{N} = \mathrm{A} + {}^{s}.006 + {}^{s}.00100\,(T - 1875)$$

Combining this with the difference depending on the Declinations, page 165, the reduction in Right Ascension for any time T has the form

$$\mathrm{N} = \mathrm{A} + \Delta\alpha + \Delta\mu\,\frac{(T - 1875)}{100}$$

with a similar expression for the Declination.

In the table, divisions A and B give the data for reducing the Right Ascensions and Declinations respectively from the system of Auwers to that of Newcomb; C for reducing the declinations to the system of Boss.

Declination.	A		B		C	
	$\Delta\alpha$	$\Delta\mu$	$\Delta\delta$	$\Delta\mu'$	$\Delta\delta$	$\Delta\mu'$
	s	s	″	″	″	″
+ 85°			— .00	+ .37	— .04	+ .30
80	— .017	+ .119	+ .03	+ .45	— .07	+ .30
75	— .008	+ .127	+ .04	+ .46	— .10	+ .27
70	— .000	+ .129	+ .02	+ .32	— .13	+ .10
65	+ .004	+ .127	+ .03	+ .27	— .14	— .00
60	+ .005	+ .124	+ .09	+ .26	— .10	— .10
55	+ .005	+ .123	+ .19	+ .32	— .04	— .10
50	+ .002	+ .128	+ .22	+ .36	+ .04	— .10
45	— .014	+ .111	+ .30	+ .09	+ .07	— .35
40	— .012	+ .109	+ .32	— .72	+ .08	— 1.20
35	— .009	+ .096	+ .29	— .86	+ .06	— 1.33
30	— .004	+ .090	+ .26	— .81	+ .05	— 1.22
25	+ .004	+ .091	+ .24	— .85	+ .06	— 1.18
20	+ .006	+ .093	+ .24	— .94	+ .09	— 1.27
15	+ .009	+ .094	+ .31	— 1.00	+ .15	— 1.36
10	+ .011	+ .098	+ .36	— .98	+ .18	— 1.31
+ 5	+ .012	+ .103	+ .36	— .92	+ .19	— 1.24
0	+ .012	+ .108	+ .39	— .80	+ .20	— 1.16
— 5	+ .012	+ .113	+ .42	— .75	+ .23	— 1.14
— 10	+ .010	+ .113	+ .55	— .80	+ .34	— 1.25
— 15	+ .010	+ .115	+ .74	— .72	+ .48	— 1.30
— 20	+ .009	+ .116	+ .89	— .54	+ .58	— 1.30
— 25	+ .009	+ .125	+ .99	— .44	+ .66	— 1.40

The reduction for proper motion is the second term in each of the above expressions. For example, for Declination 80°

$$\mu_N = \mu_A + .00119\ (T - 1875)$$

$$\mu'_N = \mu'_A + .0045\ \ (T - 1875)$$

$$\mu'_B = \mu'_A + .0030\ \ (T - 1875)$$

The results of a direct comparison of the stars common to the catalogues of Newcomb and Auwers will be found in No. 3742, *Astronomische Nachrichten*, in an article by Dr. Fritz Cohn entitled "Vergleichung des Newcomb'schen Fundamenentalcatalogs mit dem Auwers'schen A. G. C."

In the pages which follow the column headed *B. A. C.* gives the number corresponding to the star's place in the British Association Catalogue, with the exception of five not found in that publication. The magnitudes are from various sources and do not claim great precision. The column headed *A* gives the number of authorities employed in deducing the corresponding coordinate. Where N or D occurs in this column it implies that the corresponding coordinate is taken from Newcomb or Davis, as the case may be.

The differential coefficients include the proper motions μ and μ' in accordance with the formulæ given on page 287.

To illustrate the reduction to any epoch, let the Right Ascension and Declination of No. 3 be required for 1755:

$$1755 - 1875 = -120$$

Therefore

$$\alpha_{1755} = 0^h\ 10^m\ 33^s.963 - 120 \times 3^s.11489 + \tfrac{1}{2}\,(120)^2 \times 0^s.0002643 + 0^s.019 \times (-1.20)^3.$$

$$= 0^h\ 4^m\ 22^s.046$$

$$\delta_{1755} = 37^\circ\ 59'\ 14''.89 - 120 \times 20''.0272 + \tfrac{1}{2}\,(120)^2 \times (-0''.000295) - 0''.175 \times (-1.20)^3$$

$$= 37^\circ\ 19'\ 9''.80$$

Auwers' Bradley gives

$$\alpha = 0^h\ 4^m\ 22^s.08$$

$$\delta = 37^\circ\ 19'\ 10''.0$$

Definitive Positions 1875.0.

	B. A. C.	Mg	α 1875.0	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$	μ	δ 1875.0	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$	μ′	$\frac{A}{\alpha}$	$\frac{A}{\delta}$
			h m s					° ′ ″						
1	16	5.1	0 3 49.785	3.09580	+.0003283	+ .025	+.00092	45 22 35.55	20.0460	−.000162	— .171	—.0054		N
2	LL 220	7.5	10 12.247	3.12214	2468	.017	+.00069	35 47 41.51	20.0815	289	.174	+.0501	9	11
3	52	5.	10 33.963	3.11489	2643	.019	—.00547	37 59 14.89	20.0272	295	.175	—.0057	23	26
4	*60	6.2	12 7 151	3.13969	3169	.023	+.00133	43 5 48 13	20.0200	328	.178	—.0062	19	19
5	99	6.5	21 28.282	3 11329	1350	.011	—.00159	18 49 21.31	19.9573	510	.173	—.0090	16	18
6	126	4.2	0 25 51.538	3 35929	+ 7016	.070	+.00049	62 14 29.79	19.9212	— 639	— .217	—.0050		N
7	194	5.6	37 25.783	3.83965	16084	.270	—.00617	74 18 15.76	19.7567	994	.319	—.0307		N
8	222	4.6	42 11.898	3.10632	785	.009	+.00444	6 54 15.47	19.6803	915	.170	—.0349		N
9	259	3.9	49 49.230	3.30819	3068	.018	+.01211	37 49 14.99	19.6203	1129	.204	+.0380		N
10	318	5.0	1 00 50.736	3.41633	3822	.022	+.01410	43 16 31.70	19.2915	1396	.223	—.0602	20	22
11	361	7.	1 6 30.266	3.01720	+ 186	+ .009	—.00504	— 7 26 49.97	19.1745	— 1340	— .153	—.0413	15	16
12	394	6.7	12 45 553	3 93545	9621	.085	+.00744	64 0 6.49	19.0228	1877	.331	—.0293	17	18
13	360	2.	12 59.80	20.8603	15057		.1229	88 38 33.81	19.0457	9659		+.0051		N
14	413	6.7	17 7.878	3.21167	1538	.009	+.00304	17 9 58.18	18.8985	1630	.182	—.0307	13	12
15	438	6.0	21 57.528	4.35677	14364	.157	+.02478	69 37 13.22	18.7107	2318	.436	—.0748		N
16	459	7.0	1 25 55 826	3.17059	+ 1217	+ .008	+.00105	11 14 19.72	18.6672	— 1774	— .174	+.0061	12	12
17	480	4.2	29 28.033	3.49478	3635	.016	—.01629	40 46 45.47	18.1746	2010	.230	—.3709		N
18	502	4.9	33 12.172	3.51639	3603	.016	+.00127	39 56 35.06	18.3968	2109	.233	—.0217		N
19	592	5.8	50 31.460	3.26527	1637	.007	+.00101	17 12 22.78	17.7500	2286	.182	—.0171	32	32
20	611	5.6	53 46.264	4.36499	10502	.070	—.00047	63 47 5.72	17.6345	3107	.414	+.0010		N
21	656	3.1	2 2 6.635	+ 3.54883	+ 3043	+ .009	+.01168	34 23 41.61	17.2389	— 2712	— .226	—.0355		N
22	706	6.	11 13.393	3.83707	4751	.014	—.00658	46 48 6.64	16.8415	3099	.277	—.0143	18	21
23	744	4.6	18 47.640	4.84970	13108	.077	—.00157	66 50 19.39	16.4952	4096	.518	+.0074		N
24	780	6.5	26 3.504	3.27527	1508	.004	—.00241	14 28 47.55	16.1580	2910	.170	+.0402	25	23
25	816	6.5	31 6.927	4.24693	6562	.015	+.00109	54 34 14.64	15.6597	3929	.344	—.0286	16	18
26	872	3.7	2 42 37.769	3.51532	+ 2274	+ .002	+.00414	26 44 37.80	15.1107	— 3410	— .197	—.1028		N
27	916	6.0	51 35.637	3.84960	3616	.001	—.00082	40 31 59.00	14.6504	3884	.250	—.0405	8	10
28	963	V.	3 0 2.196	3.87871	3554	.000	—.00031	40 28 20.47	14.1824	4061	.244	+.0045		N
29	981	5.0	3 13.561	3.84883	3368	— .001	—.00340	39 8 6.03	13.9878	4081	.234	+.0083	20	22
30	993	6.0	6 39.151	3.95407	3713	— .001	+.00518	42 2 5.78	13.7791	4259	.249	+.0164	14	17
31	1050	6.5	3 17 24.064	6.09182	+ 17880	+ .020	+.00106	71 25 31.49	13.0686	— 6798	— .747	+.0046	12	13
32	1068	3.8	20 23.777	3.24316	1167	.000	+.00305	9 17 43.01	12.8274	3687	.136	—.0366		N
33	1119	6.4	32 21 681	3.38265	1421	— .002	+.00128	16 7 42.19	12 0132	3998	.143	—.0304	23	22
34	1144	4.6	38 5.857	5.41987	10153	.026	+.00185	65 8 12.27	11.6256	6485	.493	—.0130	18	18
35	1221	6.0	49 29.036	3.53321	1598	.005	+.00340	22 6 57.66	10.7081	4390	.146	—.1052	31	28
36	1237	4.9	3 54 2.951	4.95181	+ 6417	— .032	—.00335	58 48 19.96	10.4740	— 6199	— .351	—.0006	14	18
37	1274	5.8	4 1 53.137	3.48607	1379	.006	+.00697	19 16 36.53	9.8497	4475	.129	—.0342		N
38	1286	5.6	5 53.105	5.23925	6978	.048	+.00063	61 31 58.83	9.5639	6755	.371	—.0136	13	16
39	1307	5.6	9 50.643	4.47574	3766	.026	+.00359	49 44 29.36	9.2099	5832	.237	—.0623	13	16
40	1364	6.5	18 9.030	3.80681	1792	.012	+.00483	31 9 16.66	8.5057	5056	.142	—.1161	17	17
41	1425	6.0	4 30 4.391	4.70174	+ 3678	— .039	+.00035	52 49 39 86	+ 7.6519	— 6369	— .223	—.0166	16	16
42	1444	5.9	33 30.448	3.74561	1457	.012	+.00218	28 22 14.07	7.3602	5113	.117	—.0298	19	18
43	1486	3.3	43 3.312	3 25165	722	.005	+.03020	6 44 27.92	6.6416	4548	.072	+.0345		N
44	1496	6.0	46 30.153	7.52098	13291	.292	+.00303	74 4 17.30	6.3515	10441	.606	+.0298	11	16
45	1536	4.2	52 18.315	5.30905	4186	.077	—.00165	60 15 22.91	5.8237	7430	.232	—.0140		N
46	1555	7.0	4 56 54.749	3.56872	+ 921	+ .011	+.00001	21 6 1.57	+ 5.4353	— 5032	— .076	—.0156	16	16
47	1568	5.3	5 0 3.774	3.54044	836	.010	+.03669	18 28 30.56	5.2123	5062	.070	+.0272	38	38
48	1583	6.7	1 53.740	5.55689	4176	.096	—.00509	62 32 1.37	5.0380	7859	.224	+.0079	13	16
49	1598	6.8	6 30.813	9.34113	17142	.728	—.00238	78 16 57.33	4.6398	13270	.743	+.0019	12	12
50	*1611	5.0	5 6 45.382	3.13271	513	.005	—.00113	2 42 37.77	4.6206	4464	.046	+.0034	20	19
51	*1625	7.0	5 9 25 519	3.50302	+ 725	— .010	—.00060	18 17 52.85	4.3856	— 5003	— .058	—.0040	9	11
52	1687	1.7	18 25.625	3.21446	478	.006	—.00144	6 14 4.10	3.6099	4625	.038	—.0079		N
53	1662	6.4	22 8.816	18.55094	63412	8.022	+.01181	85 7 35.66	3.2903	26717	2.483	—.0069		N
54	1706	6.3	23 1.262	7.98044	7698	.436	—.00156	74 57 22.57	3.2342	11499	.349	+.0124		N
55	1751	5 5	29 55.061	5.99596	2712	.144	—.00177	65 37 34.15	2.5911	8678	.136	—.0337	14	17

* Maj.

	B. A. C.	Mg.	α 1875.0	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$	μ	δ 1875.0	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$	μ′	$\frac{A}{\alpha}$	$\frac{A}{\delta}$
			h m s					° ′ ″						
56	1789	6.0	5 33 17.560	+ 2.98760	+ .0000324	— .004	—.00026	— 3 38 10.93	+ 2.3379	—.004337	— .020	+.0062	15	14
57	1813	6.3	39 29.025	6.43751	2256	.195	—.00332	68 25 52.32	1.7300	9354	.107	—.0629	11	15
58	1821	6.0	39 34.191	3.44764	383	.010	—.00070	15 46 17.27	1.7864	5015	.021	+.0011	22	21
59	1846	5.3	42 31.641	3.36855	333	.009	— 00190	12 36 34.46	1.5116	4902	.016	—.0158	16	16
60	1862	6.0	45 16.259	3.40621	318	.009	—.00210	14 8 16.31	1.2898	4960	.014	+.0018	23	23
61	1874	7.0	5 47 50.816	+ 6.21420	+ 1221	— .171	—.00295	66 59 52.43	+ 1.0172	— 9050	— .053	—.0457	11	16
62	1923	6.0	54 17.298	4.32443	258	.033	+.00965	42 54 45.79	0.3511	6321	— .006	—.1487	23	23
63	1942	6.0	57 58.099	4.13501	182	.027	—.00032	38 29 28.93	+ 0.1357	6031	+ .002	—.0420	16	15
64	1970	6.5	6 2 0.277	3.61559	+ 141	.013	—.00245	22 12 28.27	— 0.1745	5268	.006	+.0008	20	19
65	2007	4.3	8 35.616	5.30028	— 399	.086	—.00012	59 3 10.51	0.7247	7721	.039	+.0271		N
66	2045	5.5	6 15 54.004	+ 5.24501	— 812	— .082	—.00218	58 28 56.15	— 1.3973	— 7622	+ .064	—.0072	18	18
67	2083	6.2	22 7.380	7.61230	4089	.378	— 03654	73 47 14.26	1.9664	10989	.214	—.0337	10	11
68	2101	7.5	22 48.877	3.62401	130	.013	—.00270	22 37 32.72	1.9910	5247	.034	+.0021	12	13
69	2126	4.4	26 8.672	3.24526	15	.007	—.00008	7 25 21.07	2.2870	4692	.028	—.0042		N
70	2139	6.7	27 57.173	4.12875	506	.025	—.00071	38 32 37.82	2.4613	5965	.057	—.0215	13	13
71	2159	5.1	6 30 24.188	+ 4.28990	— 698	— .031	—.00077	42 35 46.54	— 2.7119	— 6189	+ .069	—.0594	16	19
72	*2187	5.1	35 11.272	5.31695	2019	.084	—.00411	59 33 53.72	3.0706	7644	.135	—.0037	19	21
73	2233	6.0	44 3.520	3.59865	389	.012	—.00132	21 54 23.21	3.8614	5133	.060	—.0298	23	21
74	2301	6.5	55 33.689	3.81888	884	.015	+.01101	29 32 40.18	5 6255	5402	.091	—.8112	21	18
75	2317	6.3	7 1 33.458	11.67981	35652	1.495	+.00525	81 28 40.56	5.3582	16407	1.498	—.0362	15	19
76	2341	5.6	7 3 38.299	+ 4.69611	— 2349	— .044	—.00027	51 37 59.68	— 5.4925	— 6562	+ .171	+.0048	13	14
77	2358	4.1	5 28.829	3.06513	155	.004	—.00067	— 0 17 15.48	5.6309	4264	.057	+.0212		N
78	2365	7.7	7 48.006	5.20696	3758	.068	—.00529	59 8 14.81	5.8709	7231	.237	—.0243	13	14
79	2410	3.6	12 39.388	3.58903	726	.010	—.00189	22 12 37.58	6.2573	4944	.095	—.0056		N
80	2439	5.8	17 51.282	6.30888	8341	.142	+.00058	68 43 2.93	6.7301	8647	.438	—.0479		N
81	2473	4.8	7 22 50.261	+ 3.34290	— 523	— .006	—.00117	12 15 47.15	— 7.1017	— 4528	+ .088	—.0099		N
82	2488	5.8	27 26.887	4.37485	2480	.027	—.00280	46 27 12.20	7.4767	5886	.191	—.0091	11	11
83	2509	4.9	31 0.239	3.92828	1587	.015	—.00307	34 52 7.63	7.8851	5246	.149	—.1296		N
84	2551	3.7	36 53.968	3.63058	1096	.009	—.00233	24 41 44.71	8.2801	4790	.127	—.0515		N
85	2616	7.0	46 18.214	4.90192	4898	.039	+.00035	56 49 49.34	8.9950	6355	.305	—.0231	14	17
86	2585	6.6	7 46 43.781	+15.27834	— 123878	—1.757	—.00257	84 24 41.75	— 9.0370	— 19867	+4 573	—.0318	23	18
87	2660	5.4	53 29.442	2.99857	271	.001	—.00501	— 3 20 25.95	9.5220	3800	.087	+.0079	21	21
88	2676	6.3	56 27.588	3.54958	1169	.006	—.00455	22 25 9.48	9.7558	4475	.140	+.0018	16	16
89	2704	6.0	59 47.628	4.96971	5950	.034	— 00122	58 36 41.87	10.0901	6235	.352	—.0786	12	13
90	2786	5.2	8 12 28.130	3.65640	1661	.006	—.00176	27 37 14.44	11.3336	4417	.169	—.3769		N
91	2792	5.	8 14 19.908	+ 4.58132	— 4951	— .018	—.00274	53 37 12.17	—11.1928	— 5515	+ .314	—.0999	17	18
92	2819	3.5	19 51.800	5.04253	7647	.021	—.01719	61 8 1.23	11.6083	5957	.418	—.1155		N
93	2880	6.5	28 8.194	3.45679	1271	.002	—.00429	20 1 5.96	12.0785	3967	.158	.0000	21	21
94	2953	4.2	37 34.766	3.41847	1271	.001	—.00172	18 36 44.03	12.9579	3796	.160	—.2303		N
95	2982	5.5	43 3.436	5.00819	8968	.001	—.00328	62 25 39.75	13.0708	5472	.463	+.0237	27	24
96	3003	6.0	8 45 53.055	+ 5.22336	— 10816	+ .007	—.00501	65 4 47.54	—13.3693	— 5645	+ .524	—.0886	24	23
97	3052	6.0	50 36.236	3.35833	1157	.000	+.00301	16 3 35.26	13.5503	3547	.161	+.0371	26	23
98	3083	6.7	56 30.430	4.25797	5131	.001	—.01300	51 19 12.87	14.0420	4384	.319	—.0793	13	13
99	3109	6.0	9 0 29.562	3.61621	2148	.001	—.00407	30 9 19.01	14.2047	3656	.206	+.0062	17	17
100	3140	5.0	7 10.877	4.36340	6123	.008	+.00625	54 32 11.05	14.5532	4300	.354	+.0646	24	25
101	3170	6.5	9 11 56.642	+ 3.52033	— 1924	+ .002	—.00348	26 46 37.94	—14.9166	— 3369	+ .199	—.0167	9	11
102	3228	6.0	21 49.756	3.20010	838	.003	—.00289	8 43 56.79	15.4741	2902	.157	—.0093	13	14
103	3231	6.0	23 3.368	5.81249	21387	.152	+.01541	72 45 30.61	15.6072	5309	.799	—.0743	14	17
104	3281	6.0	30 33.134	3.76960	3445	.007	—.00295	40 47 59.00	15.9282	3265	.255	+.0113	19	21
105	3307	6.0	34 15.307	3.73939	3391	.008	—.00689	40 19 34.69	16.1742	3164	.252	—.0402	15	17
106	3375	7.0	9 46 9.550	+ 3.59771	— 2823	+ .009	—.00171	35 34 15.89	—16.7336	— 2820	+ .233	—.0030	15	14
107	3397	6.0	50 3.213	3.81469	4309	.015	—.00137	46 0 31.54	16.9601	2914	.278	—.0440	9	12
108	3468	6.0	10 3 48.030	3.57424	3096	.013	—.00551	38 1 0.17	17.5653	2452	.237	—.0340	11	12
109	3505	3.6	9 33.103	3.64573	3827	.017	—.01532	43 32 15.51	17.8074	2378	.254	—.0372		N
110	3495	5.6	11 9.018	9.80634	160804	6.885	—.09600	84 53 5.94	17.8886	6400	3.294	—.0540		N

* Mean A.B.

	B. A. C.	Mg.	α 1875.0	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$	μ	δ 1875.0	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$	μ'	$\frac{\Delta}{\alpha}$	$\frac{\Delta}{\delta}$
			h m s					° ′ ″						
111	3530	6.0	10 14 44.321	+ 3.59054	—.0003573	.016	—.01279	41 51 47.04	—18.1164	—.002235	+ .246	—.1404	21	21
112	3551	6.1	17 7.409	3.03233	159	.007	—.00501	— 3 26 35.23	18.0605	1838	.151	+.0070	20	18
113	3584	6.0	22 48.377	3.52476	3229	.015	—.00202	39 33 50.76	18.2753	2035	.235	+.0024	16	19
114	3647	5.0	33 23.690	4.17155	11213	.108	—.02817	66 22 13.50	18.7145	2150	.388	—.0752	23	25
115	3693	5.8	39 47.972	3.18389	1035	.009	—.00992	14 51 14.67	18.8904	1506	.179	—.0516	39	36
116	3725	5.1	10 45 59.573	+ 3.67412	— 5908	.042	—.00967	55 14 56.39	—19.0313	— 1614	.274	—.0136	21	23
117	3751	7.0	49 47.288	3.26704	1770	.012	—.00332	26 10 1.59	19.1295	1353	.195	—.0090	15	15
118	3787	7.8	58 35.045	3.21245	1677	.012	—.03152	25 52 40.14	19.3981	1146	.186	—.0596	17	18
119	3825	6.7	11 5 27.361	3.52927	5624	.045	—.00283	55 34 23.41	19.4987	1129	.248	—.0097	11	14
120	3877	4.0	17 24.428	3.13061	654	.010	.00937	11 13 3.04	19.7823	761	.175	—.0734		N
121	3914	4.1	11 23 57.710	+ 3.63952	— 11151	.154	—.00860	70 1 14.71	—19.8307	— 744	+ .274	—.0239		N
122	3949	6.0	31 6.713	3.27501	4171	.035	—.00710	51 18 38.87	19.9299	514	.202	—.0348	11	13
123	LL. 22186	7.5	37 35.183	3.14463	1757	.015	—.00382	30 16 25.28	19.9408	361	.179	+.0176	5	5
124	4010	6.4	45 46.132	3.47944	3134	.032	.34093	38 36 55.24	25.7877	321	.240	—5.7721		N
125	W.B. 956	7.0	49 54.785	3.12117	— 2712	.023	—.00537	42 42 33.60	20.0439	— 114	.176	—.0091	7	8
126	4063	7.0	11 57 11.829	+ 3.06441	422	+ .010	—.00647	— 4 46 59.70	—20.0549	32	+ .166	—.0022	20	16
127	4070	5.7	58 25.584	3.15165	— 48131	3.874	—.06178	86 16 47.85	19.9778	55	.191	+.0760	29	26
128	4074	6.0	59 20.134	3.07126	5797	.069	—.00880	63 37 53.58	20.1359	73	.168	—.0818	19	19
129	4099	6.5	12 4 9.300	3.06241	722	.011	—.00219	17 30 17.81	20.0439	167	.165	+.0070	18	18
130	4123	3.4	9 13.914	3.00081	4260	.044	.01382	57 43 38.27	20.0356	263	.156	+.0024		N
131	4141	6.	12 13 0.273	+ 3.03607	— 1015	.013	—.00284	23 43 45.16	—20.0327	+ 337	.161	—.0108	20	19
132	4195	4.6	20 42.369	2.99891	1257	.014	—.00657	28 57 48.51	20.0527	480	.155	—.0803		N
133	4217	6.0	24 7.806	2.85950	2969	.030	—.03144	52 13 32.78	19.9400	519	.135	+.0032	21	20
134	4239	3.9	28 8.244	2.59786	5412	.087	—.01261	70 28 39 03	19.8964	547	.101	+.0069		N
135	4271	5.1	35 33.461	3.03725	165	.010	.00188	10 55 29.28	19.9102	771	.160	—.0969		N
136	4300	6.	12 41 58.304	+ 2.58448	— 3569	.046	—.00020	63 27 49.45	—19.7291	+ 771	.100	—.0102	13	14
137	4318	7.	45 59.257	2.98460	436	.011	—.00232	17 45 15.18	19.6561	952	.151	—.0043	15	14
138	4371	6.	56 53.585	2.36184	2704	.038	—.02840	64 16 55.50	19.4285	920	.077	+.0109	15	D
139	4403	6.7	13 3 39.125	2.95067	297	.010	—.00589	17 30 56.71	19.2846	1261	.145	+.0011	10	D
140	4433	5.5	8 2.768	2.72915	1348	.016	—.00529	40 48 54.77	19.1675	1245	.114	+.0093	19	15
141	4467	5.7	13 14 42.758	+ 2.69642	— 1244	+ .015	—.00615	40 48 26.06	—19.0115	+ 1338	+ 110	—.0135		N
142	4510	5.4	23 51.663	2.21159	1520	.021	—.01198	60 35 30.75	18.7026	1228	.066	+.0240		N
143	*4562	5.8	34 42.246	2.86584	— 215	.009	—.00473	20 35 19.01	18.3386	1755	.128	+.0277	28	23
144	4604	7.0	42 11.369	+ 3.09164	800	+ .007	—.00292	— 2 12 59.63	18.0891	+ 2021	.158	+.0044	12	14
145	4643	6.3	45 59.908	— 2.04548	+ 54886	—2.010	+.02175	83 22 45.61	18.0066	— 1240	.668	—.0593	19	23
146	4694	7.2	14 0 53.630	+ 2.66069	— 374	+ .009	.00002	31 26 53.82	—17.4277	+ 2028	+ .101	—.0994	17	14
147	4701	6.0	3 37.069	2.24714	626	.010	—.00533	50 2 58.10	17.1566	1753	.066	+.0504	21	21
148	4728	6.0	9 21.039	2.42131	496	.009	—.00461	42 6 22.85	17.0451	1958	.079	—.1011	14	12
149	4758	6.0	14 39.780	2.46386	416	.009	—.00028	39 22 9.29	16.6933	2063	.081	—.0024	17	17
150	4825	6.2	29 31.903	2.45312	224	.007	—.00354	37 10 33.39	15.9886	2238	.078	—.0536	17	17
151	4841	6.0	14 33 30.806	+ 2.25487	— 212	.007	—.01069	44 10 55.50	—15.6918	+ 2100	+ .064	+.0293	16	19
152	4874	6.2	38 56.377	1.48735	1046	— .005	+.00866	61 47 42.71	15.4542	1461	.045	—.0323	16	19
153	4905	4.6	45 37.472	2.76605	217	+ .005	+.00903	19 37 14.04	15.1218	2741	.102	—.0803		N
154	4926	5.7	50 19.265	2.82767	354	+ .004	—.00299	14 57 9.49	14.7674	2851	.106	—.0009		N
155	4949	4.9	55 36.075	0.93382	2856	— .021	—.01339	66 25 50.42	14.4330	993	.058	+.0170		N
156	4974	4.9	14 59 40.343	+ 1.97993	195	.003	—.03865	48 8 30.82	—14.1646	+ 2060	+ .049	+.0361		N
157	5000	7.2	15 5 35.112	2.42969	72	.004	—.00047	33 33 11.89	13 8331	2625	.070	—.0023	11	10
158	5072	5.3	16 48.324	2.40058	136	.004	—.00477	33 22 55.55	13 0931	2701	.065	+.0104	16	21
159	5113	6.7	25 24.620	1.90462	376	.001	—.00212	48 8 35.78	12.5294	2221	.044	—.0050	15	14
160	5147	5.9	25 10.716	0.82293	2658	— .018	—.01874	64 37 46.26	12.1847	981	.057	+.0806	15	20
161	5180	5.8	15 35 14.345	+ 2.75440	412	+ .002	+.00032	16 25 44.63	—11.8507	3293	.082	—.0093	21	20
162	5210	6.5	39 26.853	1.62603	721	— .002	—.00812	52 45 22.11	11.5070	1979	.038	+.0352	15	15
163	5236	6.0	43 25.472	2.46853	265	+ .002	—.00190	28 32 28.75	11.2549	3026	.062	+.0011	16	19
164	5271	4.6	48 21.287	2.07185	178	+ .001	+.03903	42 48 8.18	10.2675	2631	.042	+.6288		N
165	5295	5.5	51 14.803	+ 2.18162	271	+ .001	+.00323	38 18 32.54	10.5978	+ 2743	.046	+.0844	19	20

* Maj.

	B. A. C.	Mg.	α 1875.0	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$	μ	δ 1875.0	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$	μ'	$\frac{A}{\alpha}$	$\frac{A}{\delta}$
			h m s					° ′ ″						
166	B.D.72.703	7.0	15 56 54.384	— 0.63714	+.0007861	.054	—.01014	72 44 57.06	—10.2427	—.000767	+ .168	+ .0179	6	7
167	5325	6.4	57 34.955	+ 2.96095	631	.001	—.00389	5 19 56.97	10.1956	+ 3756	.086	+.0169	19	16
168	5343	6.5	58 1.161	— 1.51902	13021	.090	+.00588	75 55 51.43	10.1955	— 1858	.297	—.0187	15	16
169	5366	6.0	16 2 26.482	+ 2.88865	553	.000	—.00184	8 52 4.99	9.8430	+ 3711	.079	—.0015	18	17
170	5405	6.0	7 4.377	+ 2.96279	614	.001	+.00069	5 20 31.84	9.4868	+ 3849	.081	—.0003	18	16
171	5462	5.5	16 14 24.859	— 1.80071	+ 12648	— .059	—.00052	76 11 29.11	— 8.9127	— 2293	+ .304	+.0030		N
172	5466	3.8	16 24.391	+ 2.64326	381	.000	—.00432	19 26 52.79	8.7129	+ 3500	.057	+.0463		N
173	5512	2.9	22 18.101	0.79905	1853	.010	—.00317	61 47 51.17	8.2369	1093	.044	+.0554		N
174	5568	6.0	32 32.500	1.74510	533	.002	—.00274	46 52 1.83	7.4603	2390	.029	+.0082	14	15
175	5619	5.8	39 15.046	2.21116	327	.000	—.00606	34 16 13.25	6.8496	3048	.033	+.0709	14	15
176	5658	6.0	16 44 17.644	+ 1.22618	+ 957	— .005	+.00315	55 37 55.19	— 6.5113	+ 1724	+ .028	—.0066	13	16
177	5703	6.3	49 55.234	2.45154	331	.001	—.00071	25 56 0.35	6.0480	3434	.035	— 0109	16	18
178	5752	5.5	57 4.066	+ 1.09339	959	— .005	—.00688	56 52 21.34	5.4073	+ 1549	.026	+.0306	20	16
179	5780	4.4	58 50.852	— 6.38651	30769	+ .560	+.00448	82 14 22.61	5.2927	— 8955	.924	—.0050		N
180	5774	5.9	17 1 46.818	+ 3.09194	521	— .004	—.00092	— 0 54 46.32	5.0679	+ 4385	.048	—.0281	22	21
181	5786	7.0	17 3 23.583	+ 2.47551	+ 325	— .001	—.00182	24 39 2.72	— 4.9452	+ 3519	+ .029	—.0421	13	16
182	5801	6.	5 23.866	1.14938	819	.004	—.00199	55 55 38.88	4.6969	1647	.022	+ .0358	10	10
183	5828	3.2	9 53.866	2.46114	333	.001	—.00285	24 59 16.53	4.4989	3519	.026	—.1496		N
184	5842	4.8	12 42.531	2.21177	311	.001	—.00299	33 14 9.32	4.1053	3171	.020	+.0035		N
185	5911	5.7	23 25.523	1.58640	445	— .003	—.00092	48 21 56.97	3.2017	2297	.014	—.0149		N
186	5941	2.3	17 29 7.956	+ 2.78178	+ 333	— .002	+.00695	12 39 9.19	— 2.9184	+ 4042	+ .021	—.2256		N
187	6006	4.9	37 41.102	— 0.36028	1077	+ .004	.00077	68 48 55.94	1.6344	— 513	.027	+.3151		N
188	6122	5.8	57 21.255	— 1.04540	571	+ .021	.00031	72 0 59.20	— 0.2393	— 1522	+ .016	—.0078	19	21
189	6143	3.7	18 1 25.433	+ 2.84192	181	— .003	—.00546	9 32 51.52	+ 0.2215	+ 4136	— .002	+.0969		N
190	6193	6.	8 54.682	1.99699	213	— .001	—.00345	38 44 22.70	0.7839	2902	.002	+.0043	15	13
191	6203	5.3	18 11 45.540	+ 1.86336	+ 204	— .002	—.00170	42 7 3.70	+ 1.0309	+ 2707	— .002	+ .0024		N
192	6232	6.5	15 2.707	2.31200	192	.001	—.00198	29 36 47.62	1.3258	3356	.006	+ .0102	12	14
193	6246	6.3	17 0.418	1.40442	159	.003	—.00402	51 17 36.32	1.4358	2030	.002	—.0510	14	D
194	6258	6.0	18 33.020	1.40906	136	.003	—.00336	51 14 28.25	1.6091	2036	.002	—.0122	10	15
195	6300	5.7	21 24.823	2.48523	+ 162	.001	—.00113	23 47 3.76	2.1449	3593	.013	+.0137	19	19
196	6348	5.5	18 30 25.204	+ 1.03378	— 86	— .004	—.00171	56 57 1.74	+ 2.6403	+ 1481	— .007	—.0137	19	10
197	6373	6.5	36 53.277	0.72915	— 385	.004	—.00151	60 35 43.03	3.2589	1034	.012	+.0451	10	8
198	6387	4.3	40 16.953	2.57899	+ 168	.001	—.00297	20 25 41.21	3.1726	3681	.022	—.3341		N
199	6476	6.0	51 29.318	1.58105	+ 29	.002	—.00742	48 42 13.81	4.3436	2218	.012	—.1240	13	14
200	6491	3.3	54 16.088	2.24219	+ 134	.001	—.00148	32 31 9.37	4.7073	3156	.023	+.0029		N
201	6534	5.7	19 0 12.139	+ 2.28341	+ 142	— .000	+ .00417	31 33 32.09	+ 5.1369	+ 3199	— .025	—.0706	9	11
202	6579 Pr.	6.0	8 50.808	1.55271	— 286	.002	—.01785	49 37 16.35	6.5555	2113	.022	+.6214	20	21
203	6599	4.5	12 1.813	2.07950	+ 102	.000	—.00251	37 54 43.78	6.2136	2854	.026	+.0140		N
204	6656	6.5	19 59.521	1.89539	+ 55	.001	+ .00067	43 8 42.92	6.8221	2569	.024	—.0362	11	13
205	6697	3.9	26 33.255	1.51300	— 248	— .002	+.00108	51 27 51.02	7.5200	2021	.024	+.1250		N
206	6740	4.0	19 34 26.409	+ 2.36776	+ 108	+ .001	—.00102	29 51 58.67	+ 8.0787	+ 3128	— .042	+.0468	19	20
207	6784	5.0	41 40.937	2 27490	+ 201	+ .001	.00000	33 26 16.24	8.1687	2959	.039	—.4397	25	27
208	6830	6.0	48 26.257	1.76583	— 57	— .001	—.00267	47 36 35.63	9.1315	2249	.030	—.0070	17	20
209	6876	5.7	55 24.928	1.88461	+ 28	+ .000	+.00112	45 25 54.75	9.6580	2367	.033	—.0197	12	15
210	6915	5.6	20 1 43.209	2.22602	+ 218	+ .002	—.02003	35 37 44.60	9.7303	2730	.044	—.4269	16	20
211	6962	4.2	20 9 22.335	+ 1.88520	+ 39	+ .001	+ .00067	46 26 17.74	+10.7147	+ 2277	— .036	—.0141		N
212	6998	5.3	13 51.062	2.30267	+ 191	+ .002	—.00035	34 35 35.01	11.0686	2754	.052	+.0108	14	18
213	7037	6.0	19 32.269	0.29206	— 3835	— .029	+ .00119	68 28 49.72	11.5024	301	.077	+.0330	17	19
214	7094	5.6	28 2.298	2.83728	— 88	+ .002	+.00368	12 36 0.59	12.1104	3257	.092	+.0388	20	18
215	7140	4.8	32 56.283	2.67653	+ 94	+ .003	+.00244	20 45 48.92	12.4224	3016	.081	+.0112		N
216	7138	5.0	20 33 0.477	+ 3.07585	— 440	+ .001	+.00449	0 2 53.76	+12.4130	+ 3474	— .117	—.0029	20	19
217	7178	6.0	35 59.559	— 3.46948	— 38815	— .551	+.01342	80 59 35.47	12.6219	— 3971	.862	+.0019	25	2
218	7176	6.0	37 38.525	+ 1.27913	— 988	— .007	—.00011	60 3 13.32	12.8991	+ 1386	.039	+.1673	16	14
219	7213	4.5	42 32.435	2.33413	+ 314	+ .004	—.00011	36 1 55.75	13.0627	2527	.061	+.0026		N
220	7254	5.6	48 56.674	2.09498	+ 309	+ .004	+.00258	44 42 32.10	13.4748	2207	.053	—.0053	13	15

	B. A. C.	Mg.	α 1875.0	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	$\frac{(100)^3}{G}\frac{d^3\alpha}{dt^3}$	μ	δ 1875.0	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{G}\frac{d^3\delta}{dt^3}$	μ'	$\frac{A}{\alpha}$	$\frac{A}{\delta}$
			h m s					° ′ ″						
221	7297	6.8	20 55 8.805	+ 2.28855	+ 385	+ .005	+ .01945	39 45 52.58	+14.0843	+ 2370	— .060	+ .2072	12	15
222	7326	7.0	59 11.374	2.21274	+ 429	+ .005	- .00089	41 8 4.30	14.0826	2259	.059	—.0476	16	17
223	7380	4.1	21 9 31.505	+ 2.99964	— 275	+ .001	+ .00231	4 43 55.51	14.6810	+ 2900	.126	—.0764		N
224	7438	6.0	17 2.098	— 0.54914	— 13095	— .195	+ .00906	76 29 8.40	15.2019	— 579	.210	+ .0105	15	18
225	7509	7.3	28 59.097	— 0.17576	— 10728	— .162	—.00016	75 51 14.56	15.8451	— 225	.160	—.0107	14	14
226	7522	5.8	21 32 16.307	+ 3.00552	— 226	+ .005	+.00651	5 12 30.91	+ 16.0611	+ 2570	— .135	+ .0308	19	19
227	7561	2.5	38 2.800	2.91569	— 51	+ .006	+ .00058	9 18 9.89	16.3381	2424	.129	+.0093		N
228	7597	5.0	41 32.269	0.75768	— 4063	— .052	—.01174	71 44 50.27	16.4609	547	.065	—.0433	21	22
229	7610	6.7	44 48.584	1.07125	— 2310	— .026	—.00131	69 31 17.31	16 6339	799	.050	—.0313	19	19
230	7641	5.6	50 50.663	2,92387	+ ,73	+ .006	—.00329	11 29 0.62	16.9431	2202	.130	—.0098	23	18
231	B.D.59.2444	7.4	21 55 23.038	+ 1.87498	+ 629	+ .009	—.01368	59 41 56.30	+ 17.1661	+ 1330	— .048	+ .0014	2	3
232	7685	6.0	58 21.651	3.08735	— 444	+ .006	—.00274	— 1 30 36.43	17.2535	2203	.154	—.0118	22	19
233	7712	6.0	22 1 58.058	+ 2.81316	+ 482	+ .008	—.00505	21 5 42.22	17.3875	+ 1942	.119	—.0655	17	18
234	7732 Pr.	7.5	2 36.064	— 1.82387	— 41949	—1.214	—.07011	82 16 2.88	17.4382	— 1430	.551	—.0419	14	20
235	*7760	6.2	7 47.510	+ 1.37936	— 1001	— .010	—.00390	69 30 55.01	17.7058	+ 863	.042	+ .0075	19	22
236	7796	5.1	22 15 21.940	+ 2.95157	+ 186	+ .008	+ .00006	11 31 33.48	+ 18.0168	+ 1820	— .139	+ .0166		N
237	7820	5.0	19 27.071	2.42089	1502	.015	—.00161	48 50 35.16	18.1416	1421	.080	—.0133	21	24
238	7843	5.5	24 18.856	2.73673	1053	.011	+ .00236	31 55 59.80	18.3258	1541	.113	—.0058		N
239	7915	6.0	35 53.019	2 67372	1478	.014	—.00202	39 34 23.44	18.7157	1318	.107	—.0029	12	14
240	7932	5.1	38 31.178	2.66317	1578	.015	—.00220	41 9 49.01	18.8149	1270	.106	+ .0148		N
241	7962	6.	22 44 43.689	+ 2.69296	+ 1680	+ .015	—.00053	41 17 30.61	+ 18.9762	+ 1185	— .110	—.0061	15	18
242	7978	6.7	47 28.891	2.72890	1638	.015	—.00037	39 30 12.46	19.0465	1156	.114	—.0121	9	12
243	8024	6.5	56 13.899	2.51745	2636	.027	—.00138	56 26 3.21	19.2766	925	.092	—.0064	14	12
244	8052	4.5	23 1 1.528	2.91336	1074	.011	—.00171	21 47 38 07	19.3660	997	.140	—.0279	20	21
245	8078	5.2	5 25.566	3.02596	291	.009	—.00173	8 2 29 52	19.5022	957	.157	+ .0139		N
246	8122	6.8	23 13 23.079	+ 2.17376	+ 3951	+ .068	—.01451	73 0 21.60	+ 19.6084	+ 552	— .063	—.0321	15	15
247	8195	6.	25 8.838	2.93127	2146	.018	+ .02341	38 32 58.87	19.7497	568	.144	—.0731	25	27
248	8229	4.3	32 0.619	2.92399	2500	.020	+ .00139	42 34 34.12	19.9075	431	.144	+ .0026		N
249	8252	6.5	37 0.710	2.89691	3191	.031	—.00112	52 27 33.04	19.9192	337	.139	—.0042	10	10
250	8284	6.0	43 19.993	3.02131	1612	.014	+ .00103	28 8 47.79	20.0206	235	.159	+ .0191	21	19
251	8317	7.5	23 49 18.287	+ 2.97533	+ 4392	+ .041	—.00191	56 42 59.50	+ 20.0216	+ 116	— .151	—.0108	13	14
252	8321	1.8	51 24.502	3.01540	1176	.013	—.00107	24 26 47.38	20.0143	+ 80	.163	—.0258		N
253	8356	7.0	56 21.235	2.90393	19789	.714	—.01147	82 16 38.46	20.0355	- 19	.141	—.0162	15	15
254	8365	6.5	23 58 39.339	3.07383	120	.010	+ .00142	— 1 11 50.15	20.0000	— 60	.167	—.0539	23	24

* Maj.

II.

Latitude Determination at the Sayre Observatory.

Observations for Latitude at this institution were begun April 1, 1876, and ended August 19, 1895. They may be regarded as forming four different series as follows:

First.—Determinations depending on a list of 60 pairs of stars, the observations being distributed very unequally through the years 1876, '77, '78, '85, '86, '88, '89 and '90.

Second.—A list of 109 pairs observed from December 1, 1889, to December 13, 1890, each pair with two exceptions being observed both evening and morning. Sixteen pairs were common to both the old list and the new one, but the old list was entirely

reobserved (excepting three pairs) in connection with the new one, for the purpose of connecting the two series, thus insuring continuity in the results.

Third.—Series extending from October 10, 1892, to December 27, 1893. The same list, excepting a few objectionable pairs which were replaced when possible by more favorable ones, was employed as above—107 pairs in all.

Fourth.—Observation upon 41 pairs, forming four groups, employing the method of Küstner.* All of these pairs are found in the list used in Series Three. These observations extended from January 19, 1894, to August 19, 1895. As the results of this series have already been published,† no further comment is called for in this connection.

FIRST SERIES.

The Instrument.

A Zenith Telescope of three inches aperture and forty-one inches focal length, made by E. & G. W. Blunt, of New York, was employed throughout the entire campaign. It is said to have been purchased at second-hand from the U. S. Coast Survey in 1868, or thereabout. Upon taking charge of the Department of Astronomy at Lehigh University in 1875, I found the instrument in a dilapidated condition. Before attempting any serious work it was sent to Edw. Kahler of Washington, who furnished a new level and made some other repairs.

Level Value.

This was investigated by attaching the tube to the Mural Circle of the U. S. Naval Observatory. Though the mean value may be found in this way with reasonable accuracy, the method is not adapted to investigating the question of the uniformity of curvature of the tube. Four of the six micrometers with which the circle was provided were read for each position of the bubble.

The mean of fifteen such determinations gave for one division of the level the value

$$1''.06$$

No further attention was given to the matter until 1888, when a level-trier gave the value

$$0''.80$$

* *Astronomische Nachrichten*, Bd. 126, No. 3015.

† TRANSACTIONS OF THE AMERICAN PHILOSOPHICAL SOCIETY, Vol. xx, Philadelphia, 1901.

The tube had been twice refilled in the interval. Whether from this or from some other cause there had been a change of curvature.

Except for those observations near the beginning of the period under consideration and those not far from 1888, it is obviously impossible to decide what value of the level ought to be employed. The safest plan appeared to be to exclude from the final results all those cases in which this correction was large. The limit of 1″.5 for the older observations and 2″.0 for the later ones was adopted. A few values were retained where these limits were slightly exceeded.

The Micrometer.

The value of one revolution of the screw employed during the different years, with the method of its determination, is as follows:

1876–'78	50.450 ± .009	Nine elongations of 51 Cephei and λ Ursæ Minoris.
1885–'86	50.5133 ± .0084	From the Latitude Observations.
1888	50.5633	One elongation each of 51 Cephei and λ Ursæ Minoris.

The observation of the old list in 1890 was carried on in connection with the new one. The details as to Micrometer and Level will be found in connection with the Second Series.

Method of Observing.

Previous to 1889 the Micrometer was provided with only one movable thread. One bisection of the star was made, the effort being to have the thread accurately on the star at the instant when the latter crossed the meridian as shown by the clock. This would not usually coincide with the instant of crossing the middle thread of the reticle, as it was not possible to adjust the instrument with great precision in this respect. The outstanding difference, however, was of little importance. The clock correction was determined with a small transit instrument and was always known with the requisite precision.

The level was read once, usually after bisection of the star.

A preliminary reduction of the observations up to June 20, 1877, seemed to show a tendency of the bubble occasionally to cling to the tube, thus producing fictitious level readings. After this time until the end of the work in 1878, an effort was made to overcome this difficulty, or to obtain evidence tending to show whether or not the readings were genuine, in the following manner: Whenever there was sufficient time between the stars two or more readings of the level were taken, the instrument being disturbed by

turning it slightly in azimuth after each reading. The individual readings would probably never agree exactly, even if the performance of the level were perfect, owing to want of precision in the vertical axis. Large deviations from the first reading were, however, regarded as sufficient ground for rejecting such observations.

It is perhaps an open question whether anything was gained by this procedure, as there are obvious difficulties in formulating a criterion for rejection founded on the evidence so furnished.

The work of 1885–'86 is in all essential respects a repetition of that of 1876–'78. The same star list was used with the exception of three pairs which precession had carried beyond the range of the Micrometer.

The series of 1888 was intended to be a repetition of the same procedure, with some improvements which it was hoped would add materially to the accuracy of the results. The Micrometer was thoroughly repaired and the old springs replaced with new ones. A level by Stackpole & Brother took the place of that of Kahler, which had been in use since 1876. A level-trier was also provided, with which it was proposed to make frequent tests of the sensitiveness of the tube.

Although the new level proved to be much better than the old one, it failed to meet the requirements in respect to precision, and was returned to the maker after a trial of six weeks. The difficulties in finding a tube of the required delicacy proved greater than was anticipated; a delay of nearly a year was the consequence.

Meanwhile, in the future prosecution of the work a more elaborate program had been decided upon. This included a reobservation of the old list, with the exception of the three pairs which were no longer available. It is with this part of the program that we are now concerned; that relating to the new list prepared at this time being treated in another section.

The distribution of the observations on the old star list, originally comprising 60 pairs, was as follows:

Year.	*Number of Observations.*	*Year.*	*Number of Observations.*
1876	137	1886	167
1877	178	1888	121
1878	12	1889	17
1885	115	1890	397
		Total,	1144

A number of the older observations, in which the level corrections were large or where the readings appeared to be fictitious, were excluded for reasons already given.

These are not included in the above summary. It must not be understood that this process of exclusion was employed merely as a convenient means of rejecting those determinations which gave inconveniently large residuals. On the contrary, the residuals given by the rejected observations were in the majority of cases smaller than those of many which were retained.

As may be supposed, the accuracy of these earlier observations was far below the standard since attained in this class of work. Their value lies mainly in the fact that they precede by several years the period when the problem of Latitude variation began to attract serious notice, and it may be claimed that they had some influence in directing attention to this important subject.

The probable error of a single determination for the various periods was as follows:

	″
1876	0.578
1877	.457
1885–86	.407
1888	.366
1889–90	.234

The values of the latitude for each day of observation follow. These of course depend on the values of the declination employed, no means for adjustment being at hand. In forming the means all have been given equal weight.

Latitude = 40° 36′ 20″ +

	φ	No.	Number Mean
1876 April 1	3″.93	6	
6	3.23	8	56
8	3.37	12	3″.65
10	3.86	1	
15	3.43	11	
21	4.09	16	
27	3.77	2	
Aug. 5	3.86	10	
7	4.03	13	
8	3.90	17	81
9	3.49	15	3″.56
10	3.08	15	
11	2.93	11	
1877 April 6	3.54	15	
7	4.29	11	
10	3.69	16	
11	3.44	1	
12	3.99	1	61
15	4.85	2	3.″90
16	3.94	1	
23	4.12	2	
24	4.67	1	
May 4	3.92	9	
6	4.82	2	
May 14	4.09	1	
16	3.99	1	
18	4.21	4	
28	4.22	1	
29	3.66	3	
30	4.41	1	21
31	3.35	2	3″.72
June13	3.28	2	
14	2.90	2	
17	3.18	1	
18	3.80	3	
July 30	4.99	4	
31	4.18	7	
Aug. 2	4.02	4	
4	4.79	5	
5	4 19	7	
9	4.23	5	70
10	4.32	6	4″.24
11	4.19	11	
17	3.96	10	
18	4.22	7	
20	4.05	4	
Sept. 30	4.60	2	
Oct. 1	4.14	5	
2	4.22	5	
5	4.14	3	
6	4.06	4	26
7	3.96	4	4″.09
9	4.56	1	
13	3.08	1	
15	3.16	1	
1878 Mar. 18	3.31	3	
19	3.27	1	
20	4.02	3	
22	4.60	1	12
24	2.74	1	3″.51
25	3.60	1	
26	2.98	2	

	φ	No.	Number Mean
1885 Sept. 18	4″.22	8	
19	4.01	14	
20	3.96	15	
23	3.83	12	
24	3.63	11	
25	3.26	11	
26	3.54	9	115
27	3.69	9	3″.72
28	3.73	9	
29	3.19	7	
Oct. 3	4.16	2	
5	3.96	2	
10	3.32	2	
11	2.72	2	
16	3.71	2	
1886 April 10	3 78	8	
14	3.35	6	
15	3.33	8	
17	3.44	6	
18	3.75	6	
21	3.43	5	50
23	3.55	5	3″.46
29	3.56	1	
30	3.78	1	
May 5	2.51	1	
16	2.67	2	
17	2.96	1	
May 25	3.37	2	
28	3.84	3	
30	3.30	3	
June 1	3.29	10	
4	2.96	10	
5	3.33	3	
8	3.14	8	
12	3.43	1	95
13	2.95	2	3″.32
18	2.69	5	
20	2.89	9	
25	3.82	6	
26	3.38	7	
28	3.70	8	
29	3.60	9	
30	3.61	9	
July 1	3.85	4	
3	2.81	1	
4	3.76	5	
5	4.06	2	22
Aug. 4	4.32	2	3″.86
8	3.81	2	
9	4.28	2	
10	3.42	2	
11	4.10	2	
1888 Aug. 29	3.36	10	
30	2.68	12	
Sept. 2	3.17	15	
5	3.00	12	
6	3.01	2	
13	3.36	14	
14	3.31	13	121
18	3.62	2	3″.09
19	2.85	7	
21	3 27	9	
24	2.97	9	
26	2.70	9	
29	3.02	2	
Oct. 4	2.55	3	
9	3.62	2	

	φ	No.	Number Mean
1889 Dec. 1	2″.79	1	
4	3.41	1	
6	3.21	1	
7	2.86	2	
9	3.26	2	
11	2.90	3	22
13	3.09	1	3″.10
23	3.20	2	
26	3.47	3	
27	2.59	1	
1890 Jan. 18	3.07	3	
24	2.77	1	
27	3.40	1	
Feb. 6	3.24	2	
8	3.11	2	
15	3.50	3	15
16	3.62	1	3″.31
18	2.98	2	
20	3.40	2	
Mar. 8	3.30	2	
9	3.54	1	
Mar. 29	3.04	6	
April 1	3.50	17	
2	3.53	15	
3	3.54	3	
5	3.42	13	
7	3.49	4	
10	3.60	1	88
11	3.74	6	3″.52
12	3.63	6	
16	3.64	1	
18	3.80	11	
25	2.99	1	
28	3.33	1	
30	3.41	3	
May 2	3.48	8	
5	3.46	1	
8	3.54	8	
11	3.92	1	
12	3.66	2	
15	3.74	3	43
16	3.84	3	3″.62
17	3.99	3	
20	3.26	1	
21	3.64	3	
22	3.58	5	
27	3.88	2	
28	3.36	1	
31	3.33	2	
June 1	3.50	1	
3	3.17	1	
8	3.86	2	
14	3.65	1	
15	3.65	2	
18	3.68	3	78
19	3.34	3	3″.57
20	3.58	1	
25	3.45	15	
26	3.68	16	
27	3.19	1	
29	3.64	16	
30	3.52	16	

	φ	No.	Number Mean
1890 July 5	3″.66	9	
6	3.41	8	
11	3.51	1	
18	3.74	5	
19	3.79	5	55
20	3.70	10	3″.55
21	3.18	1	
22	3.38	8	
30	3.58	3	
31	3.23	5	
Aug. 3	4.09	1	
6	4.02	6	
9	3.31	2	
10	3.17	4	
14	3.21	3	33
15	3.33	3	3″.36
20	3.00	1	
23	3.13	3	
24	3.68	1	
27	3.07	3	
30	3.06	4	
31	3.02	2	
Sept. 1	3.82	2	
7	3.26	1	
18	3.77	3	
19	3.30	3	19
23	2.95	1	3″.55
25	3.56	3	
28	3.78	3	
29	3.47	3	
Oct. 8	3.51	3	
14	2.79	3	
15	2.78	3	
21	2.94	4	31
30	3.04	3	3″.15
31	3.23	6	
Nov. 1	3.19	4	
4	3.20	2	
5	3.71	3	
Nov. 13	2.99	5	
14	2.84	2	
21	2.88	2	
22	3.21	5	
24	2.67	3	
25	3.07	1	30
27	3.44	2	3″.05
28	3.11	5	
29	3.17	2	
30	3.19	1	
Dec. 12	2.60	1	
13	3.34	1	

These values are brought together for convenience of reference, in connection with the weighted mean date of the determination.

	Weighted Mean Date	*Latitude*	*No. Obs.*		*Weighted Mean Date*	*Latitude*	*No. Obs.*
1	1876.285	40° 36′ 23.″65	56	12	1888.702	40° 36′ 23.″09	121
2	76.607	23.56	81	13	89 980	23.10	22
3	77.287	23.90	61	14	90.137	23.31	15
4	77.420	23.72	21	15	90.269	23.52	88
5	77.609	24.24	70	16	90.369	23.62	43
6	77.763	24.09	26	17	90.484	23.57	78
7	78.222	23.51	12	18	90.554	23.55	55
8	85.736	23.72	115	19	90.629	23.36	33
9	86.301	23.46	50	20	90.724	23.55	19
10	86.459	23.32	95	21	90.818	23.15	31
11	86.551	23.86	22	22	90.900	23.05	30

The most noticeable feature of this series is the progressive diminution in the mean value which seems to have taken place, the minimum value in 1876 being apparently nearly the same as the maximum in 1890.

SECOND SERIES.

December 1, 1889, to December 13, 1890.

Before beginning operations on this series the instrument was thoroughly repaired by Saegmüller, of Washington, and a level was selected from some eight or ten which he had in stock and which were regarded as particularly fine tubes. As a result the performance was greatly improved in every way, as may be seen by reference to the probable errors found on page 302.

Level Value.

The level was examined by means of the level-trier five times during the year with the following results:

Date.	*Value one division.*	*Thermometer.*	*Number determinations.*
1889 November 21–23	1.24	46°	5
December 19–21	1.43	42	6
1890 July 14–15	1.16	78	5
November 11–12	1.16	43	4

One determination consists in moving the bubble over the entire length of the scale, or at least considerably more of it than is actually employed in observation, at intervals of two divisions of the micrometer screw, then moving it in the opposite direction at the same readings of the screw. From one to two minutes' time is allowed after each setting for the bubble to come to a condition of equilibrium. About one hour will usually be employed in this operation.

An example follows for illustrating the process and for showing something of the uniformity of the tube.

One division of the screw corresponds to one second of arc in the inclination of the bar.

Thermometer 44.5°		*Micrometer*	*Bubble*		*Mean*	*Bubble*		*Mean*	*Thermometer* 44.9°
			N	*S*		*N*	*S*		
	1	48	4.5	25.2	14.85	3.7	24 4	14.05	
	2	46	6.0	26.7	16.35	5.6	26.3	15.95	
	3	44	7.4	28.1	17.75	7.5	28.2	17.85	
	4	42	9.5	30.3	19.90	9.4	30.2	19.80	
	5	40	11.4	32.2	21.80	10.8	31.5	21.15	
	6	38	12.9	33.7	23.30	12.4	33.1	22.75	
	7	36	14.5	35.2	24.85	14.4	35.1	24.75	
	8	34	15.7	36.4	26.05	15.5	36.3	25.90	
	9	32	17.9	38.6	28.25	16.9	37.6	27.25	
	10	30	19.2	40.0	29.60	18.4	39.2	28.80	
	11	28	20.8	41.5	31.15	20.1	40.9	30.50	
	12	26	22.4	43.1	32.75	21.9	42.6	32.25	
	13	24	24.0	44.7	34.35	23.1	43.9	33.50	
	14	22	24.9	45.6	35.25	24 6	45.3	34.95	
	15	20	26.7	47.4	37.05	26.2	47.0	36.60	
	16	18	28.0	48.7	38.35	27.5	48.2	37.85	

9—1	13.40	13.20
10—2	13.25	12.85
11—3	13.40	12.65
12—4	12.85	12.45
13—5	12.55	12.35
14—6	11.95	12.20
15—7	12.20	11.85
16—8	12.30	11.95
16″ =	12.74	12.44
One division =	1″.26	1″.29

The large value given in December was a source of perplexity. No satisfactory explanation for it could be found. The six individual values were as follows:

1″.48 1″.47 1″.36 1″.47 1″.36 1″.42

The value employed in reduction of the Latitude observations was 1″.245.

This level was examined about one year after the termination of this series, when it was found to have deteriorated to such an extent as to be practically worthless.

The Micrometer.

The value of one revolution of the micrometer screw was derived from thirty-seven elongations of 51 Cephei, 43 Cephei and δ Ursæ Minoris. The details are given in the following table. λ Ursæ Minoris was also observed at a number of elongations, but the results did not harmonize well, either among themselves or with those derived from the

other stars employed. This seems to have been due to the time required for the star to pass over the length of the screw. This was about $1^h\ 20^m$, the instrument being liable to considerable changes in this interval.

The range of observation was usually twenty-four revolutions, viz.: from scale reading 8 to 32, 20 being regarded as the middle of the field. The correction from progressive error, to be spoken of later, was applied when appreciable.

Assuming the value of one revolution to be $50''.5$, each determination gives an equation of the form

$$R - 50''.5 \quad . x + (T - 45°)\, y$$

Where R is the observed value of one revolution,

x the correction to the assumed value,

y the temperature coefficient,

T the thermometer reading.

	Date	*Star*	*Elong.*	*Observed R*	*Thermom.*	$T-45°$	$R-50''.5$
1	1889 Dec. 13	51 Cephei	E	50″.527	45°.5	+ 0°.5	+ .027
2	1890 Jan. 14		E	.523	34.8	− 10.2	+ .023
3	27		W	.483	31.9	− 13.1	− .017
4	April 2		W	.529	36.6	− 8.4	+ .029
5	5		W	.488	37.5	− 7.5	− .012
6	18		W	.485	37.0	− 8.0	− .015
7	Oct. 17		E	.501	54.5	+ 9.5	+ .001
8	21		E	.532	44.3	− 0.7	+ .032
9	30		E	.518	38.1	− 6.9	+ .018
10	Nov. 6		E	.508	45.1	+ 0.1	+ .008
11	10		E	.527	43.0	− 2.0	+ .027
12	Aug. 15	43 Cephei	E	.456	68.6	+ 23.6	− .044
13	23		E	.465	67.9	+ 22.9	− .035
14	23		E	.498	55.5	+ 10.5	− .002
15	24		E	.517	54.4	+ 9.4	+ .017
16	24		E	.511	54.4	+ 9.4	+ .011
17	27		E	.485	71.1	+ 26.1	− .015
18	30		E	.489	64.1	+ 19.1	− .011
19	Oct. 30		W	.472	36.0	− 9.0	− .028
20	30		W	.487	35.6	− 9.4	− .013
21	31		W	.485	36.6	− 8.4	− .015
22	31		W	.506	36.6	− 8.4	+ .006
23	Nov. 4		W	.476	32.3	− 12.7	− .024
24	4		W	.498	31.4	− 13.6	− .002
25	1889 Dec. 27	δ Ursæ Minoris	W	.467	41.1	− 3.9	− .033
26	27		E	.508	34.2	− 10.8	+ .008
27	28		W	.462	40.9	− 4.1	− .038
28	1890 Oct. 17		W	.511	56.1	+ 11.1	+ .011
29	17		W	.531	56.1	+ 11.1	+ .031
30	21		W	.531	45.5	+ 0.5	+ .031
31	21		W	.502	44.3	− 0.7	+ .002
32	30		W	.544	41.3	− 3.7	+ .044
33	30		W	.543	37.2	− 7.8	+ .043
34	Nov. 6		W	.491	47.6	+ 2.6	− .009
35	6		W	.473	45.6	+ 0.6	− .027
36	10		W	.530	44.2	− 0.8	+ .030
37	10		W	.522	44.2	− 0.8	+ .022

Giving equal weights to each of the 37 equations, we find in units of the third decimal place

$$x = +\ 2.15 \pm 2.69$$
$$y = -\ 0.367 \pm 0.262$$

Therefore

$$R = 50''.50215 - .000367\ (T - 45^\circ)$$

This is the value of R employed in the present series of Latitude Observations.

Progressive and Periodic Errors.

Two series of measurements of the screw have been made by means of the measuring engine of the U. S. Naval Observatory, designed by Prof. Harkness for investigating the photographs of the transit of Venus. This was done in February, 1891.

The correction for progressive error was adjusted by a graphic process, no assumption being made as to the law involved. The result is as follows. The first column gives the micrometer reading, the second the correction:

8	+.0202	21	+.0002
9	.0182	22	.0014
10	.0162	23	.0031
11	.0141	24	.0052
12	.0121	25	.0067
13	.0100	26	.0081
14	.0080	27	.0096
15	.0046	28	.0111
16	.0019	29	.0126
17	.0000	30	.0140
18	.0000	31	.0155
19	.0001	32	.0170
20	.0002		

If we derive this correction from the transits of the circumpolar stars observed for determining the value of one revolution of the screw, assuming the error to be uniformly progressive we have the following values:

8	and 32	+.0208	14	and 26	+.0052
9	31	.0174	15	25	.0036
10	30	.0144	16	24	.0023
11	29	.0117	17	23	.0013
12	28	.0092	18	22	.0006
13	27	.0071	19	21	.0001

The corrections deduced by means of the measuring engine were employed in this reduction.

A series of measurements was also made for the determination of the periodic errors, but the resulting probable error was of the same order of magnitude as the correction; moreover this will be pretty effectually eliminated from the mean of the observations; for these reasons no correction of this kind was applied.

The Reticle.

This was provided with three vertical threads and one horizontal, the latter for marking the middle of the field. As there were no means of making a close adjustment in collimation, the single bisection was made as formerly at the instant when the star crossed the meridian, as shown by the clock, which did not necessarily coincide with the time of crossing the thread. Except, however, in case of the few stars included whose declinations were large, the difference was not important.

The micrometer was fitted with five horizontal threads, the intervals being approximately equal to ten revolutions of the screw. These are numbered consecutively I, II, III, IV and V, a small piece of brass near one end showing the number of each thread for the purpose of avoiding mistakes in identification.

When the difference of zenith distance of the two stars forming a pair was not more than twenty revolutions, both stars were commonly bisected with number III. For greater distances II and IV were employed. I and V were not used.

It was therefore necessary to determine accurately the distance between II and IV, and as this was found to be variable to some extent, the operation must be frequently repeated. Writing II + x = IV, the following values of x, in terms of revolutions of the screw, were employed, each being the mean of ten or more determinations:

1889	December	3 —	1890	February	1	$x = .0904\,R$
1890	February	1 —		June	1	.0872
	June	1 —		August	1	.0842
	August	1 —		November	6	.0831
	November	6 —		End		.0875

The Star List.

This comprises 111 pairs, 16 of which were found in the old list. Much care was given to the selection of the stars employed, the effort being to include all favorable pairs from 0^h to 24^h which could be observed without overlapping. As ideal pairs were not always to be found, a number were included which were objectionable in one way or another. It was somewhat doubtful whether these should be included in the final discussion, but with the exception of two or three cases no important difference could be discovered between the results from these and the more ideally perfect ones.

Each pair, with two exceptions, was observed both evening and morning. The number of evening observations was 842, of morning 637.

The reduction to apparent declination was carried through twice for each date of observation, once by each of the standard formulæ, viz.:

$$\delta = \delta_0 + \tau\mu' + Aa' + Bb' + Cc' + Dd'$$

and

$$\delta = \delta_0 + \tau\mu' + g\cos(G + a_0) + h\cos(H + a_0)\sin\delta_0 + i\cos\delta_0$$

A, B, C, D, h, H, g, G and i were taken from the American Ephemeris.

The Latitude Observations.

In planning this series of Latitude determinations the effort was made to observe each pair not less than five times, both evening and morning. Practically a few pairs were observed as many as twelve times, and in a few cases the number fell short of five. The evening observations were naturally more numerous than the morning. The usual method was to begin work soon after sundown and to observe from one to three or four hours, then to begin in the morning two hours or more before daylight and to stop only when sunrise ended the operation. Some of the brighter stars were observed with the sun above the horizon.

No attention was given to arranging the pairs in groups to facilitate adjustment. Under these circumstances, in connection with the fact that considerable care has been given to the reduction of the declinations, it is perhaps doubtful whether much will be gained by such an adjustment. The attempt has been made, however, to improve the results in this manner.

For this purpose the series has been divided into ten groups as follows:

		h	m		h	m	
Group	I Right Ascension	22	20	—	0	27	11 pairs
	II	0	38	—	3	01	10
	III	3	04	—	5	34	11
	IV.	5	41	—	7	24	10
	V	7	29	—	9	35	12
	VI	9	47	—	12	36	11
	VII	12	57	—	15	06	11
	VIII	15	17	—	17	24	12
	IX	17	30	—	19	49	11
	X	19	56	—	22	16	12

Reduction to Mean of Groups.

When every pair of a given group has been observed on any night, the mean of the resulting latitudes will be based upon the mean value of the declinations of all stars of

this group. The differences between the individual values and the mean of all will furnish the corrections required to reduce the individual latitudes to the mean system. Obviously these corrections are not required when all of the pairs have been observed.

In the present case, as the observations were not arranged with reference to the groups, the number of evenings when all pairs were obtained was usually too small to furnish reliable values for these corrections. It is therefore necessary to combine for this purpose observations made on different evenings. This procedure is open to objection, but in this case no other seems available. The values of these corrections follow. They are given in units of the second decimal place.

Group	Pairs 1	2	3	4	5	6	7	8	9	10	11	12
I	+ 18	+ 8	+ 12	— 19	— 7	— 11	— 20	+ 17	+ 17	+ 14	— 29	
II	— 32	— 5	+ 82	— 23	— 6	— 16	— 5	+ 9	— 6	+ 2		
III	+ 9	+ 32	— 55	— 26	+ 12	+ 4	+ 6	— 25	+ 43	— 13	+ 13	
IV	+ 7	+ 21	— 8	— 17	— 4	— 0	— 23	— 7	+ 6	+ 25		
V	— 8	— 29	+ 10	+ 12	— 14	— 8	+ 3	— 5	+ 28	— 7	+ 15	+ 3
VI	— 17	— 10	+ 37	— 45	— 22	— 3	— 9	+ 72	— 2	+ 16	— 17	
VII	— 2	— 8	+ 47	+ 17	— 12	— 14	— 5	— 3	+ 23	+ 5	— 3	
VIII	+ 18	— 28	+ 2	+ 11	+ 90	— 16	+ 20	— 37	+ 5	+ 20	+ 12	— 7
IX	— 13	+ 21	+ 2	+ 29	— 35	— 24	+ 1	+ 13	+ 34	+ 18	— 46	
X	— 29	— 29	— 21	+ 37	— 26	— 9	+ 10	+ 8	— 4	+ 6	+ 24	+ 33

The algebraic sum of the corrections for each group should be zero, except that pairs 1 and 3 of Group VII and 5 of Group VIII were observed only at the evening culmination. For these groups therefore the reduction is to the mean of the remaining pairs.

Final Adjustment.

After application, when necessary, of the above corrections, the means in case of each group are formed for convenient intervals, which in the present case average about 26 days. The resulting values follow:

	I		II		III		IV		V		VI		VII		VIII		IX		X	
	ϕ	No.	ϕ	No.	ϕ	No.	ϕ	No.	ϕ	No.	ϕ	No.	ϕ	No.	ϕ	No.	ϕ	No.	ϕ	No.
	"		"		"		"		"		"		"		"		"		"	
1889 Dec. 1–Dec. 28	3.036	65	3.062	37							3.053	47								
1890 Jan. 14–Feb. 20			3.392	17	3.205	48	3.259	8			3.150	6	3.329	48	3.401	29				
Feb. 22–Mar. 29					3.257	15	3.420	42	3.177	10					3.543	12				
Apr. 1–Apr. 12							3.373	3	3.576	47	3.280	1			3.850	17	3.605	29		
Apr. 16–May 11									3.803	19	3.467	34					3.603	15		
May 12–June 8											3.436	29	3.550	21			3.511	21	3.403	17
June 14–July 22	3.449	56	3.547	6									3.415	44	3.622	62			3.489	47
July 30–Aug. 23	2.982	8	3.324	30											3.442	35	3.191	19		
Aug. 24–Sept. 2			3.303	26	3.071	24									3.300	3	3.420	22		
Sept. 7–Oct. 14			3.890	2	2.970	45	3.089	32									3.279	58	3.078	22
Oct. 15–Nov. 5							3.118	28	3.173	45							3.101	11	3.039	33
Nov. 13–Dec. 13	3.001	82							3.067	36	3.065	11							2.958	55

In the tabular statement which follows, the differences of the consecutive values of the latitude are given with the corresponding weight. The latter is computed by the formula

$$p = \frac{nn'}{10\,(n + n')}$$

n and n' being the number of observations corresponding to the two values of the latitude. When two differences are combined, as in the case of III–IV (Jan. 14–Jan. 20) and (Feb. 22–March 29), the value of p given is the sum of the individual weights. The primed values I–II′, etc., refer to the morning series.

		p	$\frac{1}{p}$
I– II	— .026	2.36	.4237
II– III	+ .187	1.26	.7937
III– IV	— .121	1.79	.5587
IV– V	+ .138	1.09	.9174
V– VI	+ .332	1.32	.7576
VI– VII	— .114	1.22	.8197
VII–VIII	— .207	2.57	.3891
VIII– IX	+ .187	1.49	.6711
IX– X	+ .154	2.42	.4132
X– I	— .043	3.29	.3040
I– II′	— .231	1.17	.8547
II– III′	+ .323	1.44	.6944
III– IV′	— .119	1.87	.5348
IV– V′	— .055	1.73	.5780
V– VI′	+ .002	.84	1.1905
VI– VII′	— .179	.53	1.8868
VII–VIII′	— .072	1.81	.5525
VIII– IX′	+ .245	1.07	.9346
IX– X′	+ .108	.94	1.0638
X– I′	+ .040	2.56	.3906

		p	$\frac{1}{p}$
VI– I	+ .017	2.73	.3663
IV– VI	+ .109	0.34	2.9412
VIII– II	+ .009	1.07	.9346
V–VIII	— .302	1.80	.5556
VIII– III	+ .220	2.48	.4032
VI– IX	— .112	2.36	.4237
IX– V	— .044	2.64	.3788
VII– IX	+ .039	1.05	.9524
X– VI	— .033	1.07	.9346
VIII– X	+ .132	2.67	.3745
II–VIII′	— .101	1.89	.5291
III– IX	— .319	3.73	.2681
IX– II	— .051	2.54	.3937
IV– IX	— .133	2.85	.3508
X– III	+ .108	1.48	.6757
V– IX′	+ .072	.88	1.1364
X– IV	— .078	1.51	.6623
I– V	— .066	2.50	.4000
VI– X′	+ .107	.92	1.0870
II– VI	+ .050	2.51	.3984
I– VII	+ .034	2.46	.4065

Representing by 1.2; 2.3; . . . . 1.2′; 2.3′; . . . . the required corrections to the observed differences I–II, II–III, ... the conditions to be rigorously satisfied are expressed by the 26 equations which follow:

$\frac{1}{r}$	.4237	.5937	.5587	.9174	.5576	.8197	.8801	.6711	.4132	.3040	.8547	.6944	.5348	.5780	1.1915	1.8803	.5525	.9346	1.0638	.3906	.3984				
1	1.2	2.3	3.4	4.5	5.6	6.7	7.8	8.9	9.10	10.1															
2	1.2										1.2														
3		2.3										2.3													
4			3.4										3.4												
5				4.5										4.5											
6					5.6										5.6										
7						6.7										6.7									
8							7.8										7.8								
9								8.9										8.9							
10									9.10										9.10						
11										10.1										10.1					
12	1.2																				2.6				
13		2.3	3.4													6.7	7.8								
14			3.4	4.5																					
15																		8.9							
16					5.6																				
17						6.7													9.10						
18							7.8													10.1					
19								8.9																	
20		2.3																							
21									9.10				3.4												
22									9.10					4.5											
23										10.1					5.6										
24																									
25																									
26																									

Solving these in the usual manner by correlates and employing the weights given above,

.3663																1.0871	+.487
	2.9412															.4000	+.205
		.9346														.6623	−.136
			.556													1.1364	−.002
				.4032												.6757	+.193
					.378S											.3508	
						.4237										.2681	+.330
							.9524									.3937	+.065
								.9346								.5291	−.135
									.4065							.3745	−.058
										.3745						.4065	+.046
											.5291					.9346	
												.3937				.9524	−.083
+6.1													.2681			.4237	+.041
	+4.6	+8.2												.3508		.378S	−.067
			5.8	8.3											.6757	.556	−.065
			+5.8		9.5											.4032	−.101
					9.5	+6.9										.9346	
							7.9	+10.6								.4065	+.176
									1.7	8.10						.3745	−.000
											+2.8	9.2				.5291	−.001
												+9.2	3.9			.3937	+.035
														4.9	+10.3	.2681	−.183
																.3508	
																.6757	+.010
															+5.9	+10.4	+.093
																1.5	+6.10 +.002
								10.6									+6.10 +.076
		+8.2									+2.8						−.092
				+9.5											+5.9		+.028

we derive the following system of normal equations:

	k_1	k_2	k_3	k_4	k_5	k_6	k_7	k_8	k_9	k_{10}	k_{11}	k_{12}	k_{13}
1	6.0482	.4237	.7937	.5587	.9174	.7576	.8197	.3891	.6711	.4132	.3040	.4237	1.3524
2	.4237	1.2784										.4237	
3	.7937		1.4881										.7937
4	.5587			1.0935									.5587
5	.9174				1.4954								
6	.7576					1.9181							
7	.8197						2.7065						—1.8868
8	.3891							.9416					— .5525
9	.6711								1.6057				
10	.4132									1.4770			
11	.3040										.6946		
12	.4237	.4237										1.1884	
13	1.3524		.7937	.5587			— 1.8868	— .5525					7.6675
14	1.4761			.5587	.9174								.5587
15									—.9346				
16	.7576					.7546							
17	.8197						.8197			— 1.0638			
18	.3891							.3891			—.3906		
19	.6711								.6711				
20	.7937		.7937										.7937
21	.4132			—.5348						.4132			
22	.4132				—.5780					.4132			
23	.3040					— 1.1905					.3040		
24													
25													.9346
26													

The solution of these equations gives for k_1, k_2 the values

$k_1 = +.1744$ $k_{14} = -.1370$
$k_2 = +.1268$ $k_{15} = -.1491$
$k_3 = -.0648$ $k_{16} = +.0005$
$k_4 = -.0400$ $k_{17} = -.1052$
$k_5 = +.1226$ $k_{18} = -.0579$
$k_6 = +.1198$ $k_{19} = +.1578$
$k_7 = +.0089$ $k_{20} = -.2325$
$k_8 = -.1866$ $k_{21} = -.0302$
$k_9 = -.2616$ $k_{22} = +.0118$
$k_{10} = -.0969$ $k_{23} = +.0298$
$k_{11} = -.2413$ $k_{24} = +.0701$
$k_{12} = -.0728$ $k_{25} = -.1253$
$k_{13} = +.0082$ $k_{26} = +.0243$

k_{14}	k_{15}	k_{16}	k_{17}	k_{18}	k_{19}	k_{20}	k_{21}	k_{22}	k_{23}	k_{24}	k_{25}	k_{26}	
1.4761		.7576	.8197	.3891	.6711	.7937	.4132	.4132	.3040				+ .487
						.7937							+ .205
.5587							—.5348						— .136
..9174								—.5780					— .002
													+ .193
		.7576							— 1.1905				+ .330
			.8197										+ .065
				+ .3891									— .135
	—.9346				.6711								— .058
			— 1.0638				.4132	.4132					+ .046
				— .3906					.3040				— .083
													+ .041
.5587						.7937					.9346		— .067
2.4349	.5556												— .065
.5556	1.8690	.3788										.3788	— .101
	.3788	1.5601										.3788	+ .176
			3.7705							.9346			.000
				1.5607									— .001
					1.5939	.3937					.5291		+ .035
					.3937	1.4555							— .183
							1.9745	.4132					+ .010
							.4132	2.7899				1.1364	+ .093
									2.9815	1.0870			+ .002
			.9346						1.0870	2.0216			+ .076
					.5291						1.4637		— .092
.3788	.3788							1.1364				1.5152	+ .028

1. $2 = .4237\ (k_1 + k_2 + k_{12}) = + .097$
2. $3 = .7937\ (k_1 + k_3 + k_{13} + k_{20}) = - .091$
3. $4 = .5387\ (k_1 + k_4 + k_{13} + k_{14}) = + .003$
4. $5 = .9174\ (k_1 + k_5 + k_{14}) = + .147$
5. $6 = .7576\ (k_1 + k_6 + k_{16}) = + .223$
6. $7 = .8197\ (k_1 + k_7 + k_{17}) = + .064$
7. $8 = .3891\ (k_1 + k_8 + k_{18}) = - .027$
8. $9 = .6711\ (k_1 + k_9 + k_{19}) = + .047$
9. $10 = .4132\ (k_1 + k_{10} + k_{21} + k_{22}) = + .036$
10. $1 = .3040\ (k_1 + k_{11} + k_{23}) = - .011$

1. $2' = - .8547\ k_2 = - .108$
2. $3' = - .6944\ k_3 = + .045$
3. $4' = - .5348\ (k_4 - k_{21}) = + .005$
4. $5' = - .5780\ (k_5 - k_{22}) = - .046$
5. $6' = - 1.1905\ (k_6 - k_{23}) = - .107$
6. $7' = - 1.8868\ (k_7 - k_{13}) = - .001$
7. $8' = - .5525\ (k_8 - k_{13}) = + .108$
8. $9' = - .9346\ (k_9 - k_{15}) = + .105$
9. $10' = - 1.0638\ (k_{10} - k_{17}) = - .010$
10. $1' = - .3906\ (k_{11} - k_{18}) = + .072$

The corrected differences of consecutive groups are now as follows:

I–	II	— .123
II–	III	+ .278
III–	IV	— .124
IV–	V	— .009
V–	VI	+ .109
VI–	VII	— .178
VII–	VIII	— .180
VIII–	IX	+ .140
IX–	X	+ .118
X–	I	— .032
Σ		— .001

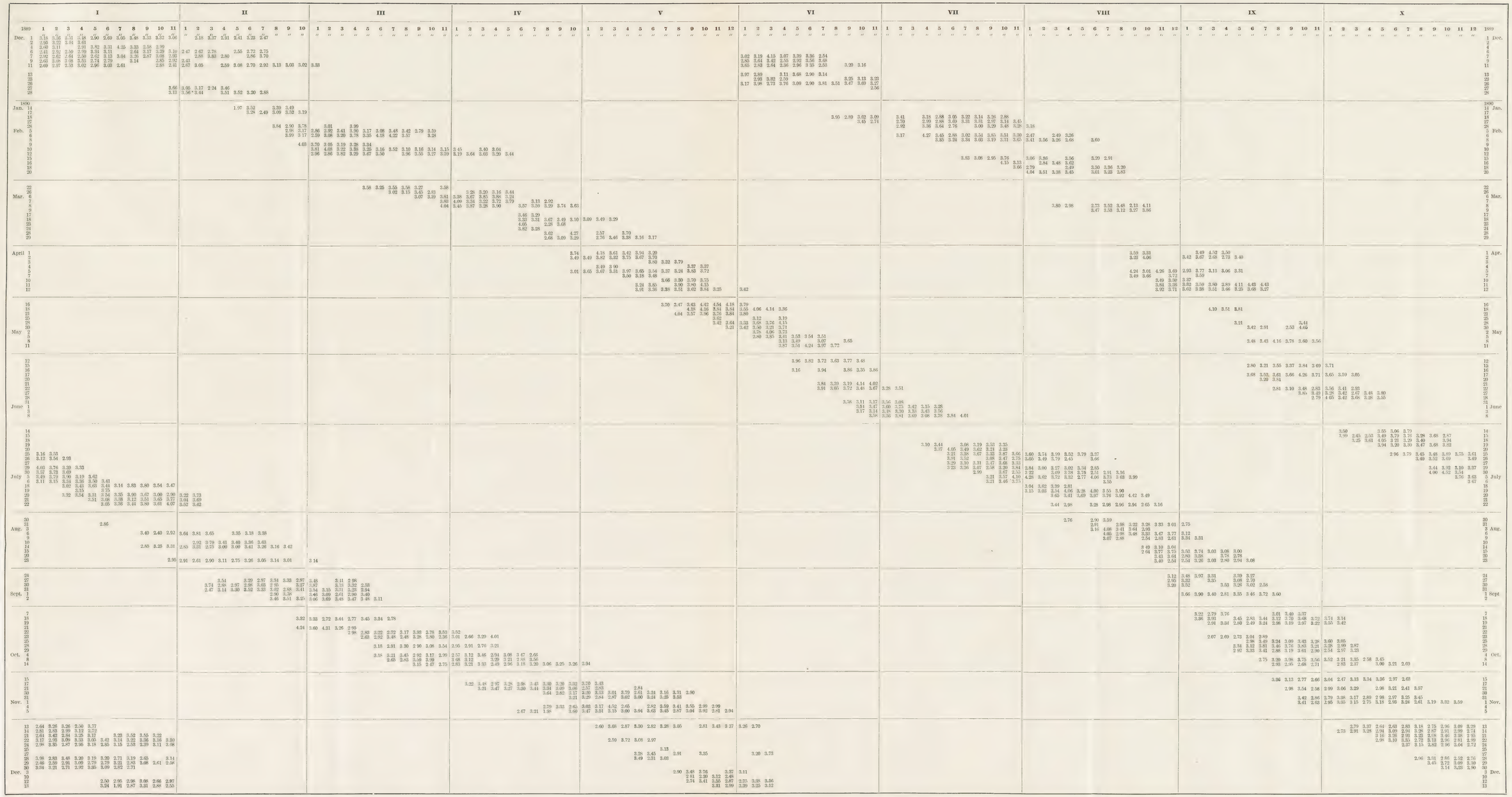
Therefore

I –	II	— .123
	III	+ .155
	IV	+ .031
	V	+ .022
	VI	+ .131
	VII	— .047
	VIII	— .227
	IX	— .087
	X	+ .031

Add to each quantity .0114 in order to make the sum of the corrections zero, we find the following series of values, which are applied to the latitudes derived from the different groups to reduce all to a homogeneous system.

	″
I	+ .01
II	— .11
III	+ .17
IV	+ .04
V	+ .03
VI	+ .14
VII	— .04
VIII	— .21
IX	— .07
X	+ .04

This system of corrections, together with those given on page 310, being applied to the individual determinations of latitude, we obtain the results given on the folding sheet, where will be found in detail the definitive latitude as given by each observation of the entire series.



Daily Mean of Latitude.

		P.M.	No.	A.M.	No.			P.M.	No.	A.M.	No.			P.M.	No.	A.M.	No.
		"						"						"			
1889 Dec.	1	3.05	17			1890 April	11	3.79	5	3.86	9	1890 Aug.	9	2.94	7		
	2	3.20	4				12	3.54	8	3.56	9		10			3.42	6
	4	3.32	9				16	3.93	7				14	3.21	3	3.13	12
	6	2.85	16				18	3.89	8	3.81	3		15	3.32	8		
	7	2.98	16	3.25	7		21	3.83	6				20	3.30	6		
	9	2.92	10	3.23	7		25	3.31	3				23	2.95	8	2.98	11
	11	2.87	19	2.96	9		28	3.66	6	3.32	2		21	3.42	6		
	13			3.28	6		30	3.41	5	3.23	4		27	3.08	5	3.26	9
	23			3.08	6	May	2	3.86	3				30	3.18	6	3.15	11
	26			3.40	11		5	3.44	6				31			3.17	13
	27	3.12	5	2.56	1		8	3.34	4	3.67	6	Sept.	1	3.49	8	3.13	7
	28	3.32	7				11	3.86	5				2			3.39	9
1890 Jan.	14	3.09	4				12	3.73	6				7	3.26	6		
	17	3.11	5				15			3.45	7		18	3.46	11	3.14	8
	18			3.21	12		16	3.63	5				19	3.10	11		
	24			3.10	2		17			3.64	9		21			3.67	5
	27			3.16	9		20			3.50	2		22			3.30	9
	28	3.50	5	3.21	9		21	3.72	5				23	2.68	5	2.99	11
Feb.	5	3.23	12				22	3.52	7	3.16	7		25	3.27	8		
	6	3.49	11	3.27	12		27			3.43	7		28	3.37	10	3.07	10
	8			3.30	12		28			3.46	6		29	3.10	10		
	9	3.43	6				31	3.30	5			Oct.	4			3.09	13
	10	3.35	14			June	1	3.46	7				8	3.34	10	3.28	10
	12	3.38	15				3	3.40	7				14	2.82	9	3.01	14
	15			3.30	9		8	3.64	8				15	2.99	11		
	16			3.44	5		14			3.48	4		17			3.30	11
	18			3.13	6		15			3.32	9		21	3.06	10	3.13	11
	20			3.35	7		18			3.54	7		30			3.16	12
	23	3.47	6				19	3.28	6	3.57	6		31	3.12	10	3.14	9
	26	3.19	8				20	3.50	6			Nov.	1	3.10	13		
Mar.	6	3.54	8				25	3.59	12	3.51	9		4			3.19	13
	7	3.50	8				26	3.32	10	3.38	7		5			3.20	16
	8	3.64	10	3.25	7		27	3.36	6				13	3.00	15	3.09	12
	9			3.45	5		29	3.13	12	3.54	8		14	2.95	16		
	17	3.38	2				30	3.12	10	3.84	6		21	3.19	17		
	18	3.35	8			July	5	3.67	12	3.63	7		22	3.12	19	3.09	4
	23	3.34	3				6	3.49	4	3.36	7		24	2.91	17		
	24	3.55	2				18	3.22	4	3.48	9		25			3.13	1
	28	3.54	4				19	3.56	8	3.45	2		27			3.32	6
	29	3.12	8				20	3.79	8	3.41	11		28	3.07	15	2.94	3
April	1	3.68	6	3.68	5		21			3.42	9		29	2.90	15		
	2	3.61	7	3.31	7		22	3.05	8	3.53	8		30	3.04	11		
	3	3.64	3				30	3.08	3			Dec.	3			3.32	5
	4	3.53	4				31	3.07	7	2.86	1		10			2.65	4
	5	3.54	11	3.49	9	Aug.	3	3.44	5				12	2.86	6	3.15	7
	7	3.39	3	3.62	4		6	3.46	7	3.30	9		13	2.79	6	3.21	5
	10	3.60	4	3.39	3												

Final Values of Latitude.

Weighted Mean Date.			φ P.M.	No.	φ A.M.	No.	Mean.	A.M.–P.M.
			"		"		"	"
1889	December	11	3.015	103	3.194	47	3.104	+.179
1890	February	4	3.345	72	3.231	56	3.288	−.114
	March	1	3.451	50	3.312	39	3.382	−.139
	April	4	3.518	60	3.578	37	3.548	+.060
	April	23	3.651	56	3.541	24	3.596	−.110
	May	22	3.566	47	3.442	38	3.504	−.124
	June	26	3.408	86	3.507	70	3.458	+.099
	July	26	3.312	57	3.415	55	3.364	+.103
	August	25	3.250	50	3.168	72	3.209	−.082
	September	22	3.213	61	3.183	43	3.198	−.030
	October	19	3.074	63	3.151	80	3.112	+.077
	November	16	3.036	84	3.158	46	3.097	+.122
	December	3	2.959	53	3.137	30	3.048	+.178
				842		637		

The probable error of a single determination computed from the daily mean of all, and therefore including that part due to the declinations employed, is found to be as follows:

Evening observations	$''$0.223
Morning observations	0.246

The Constant of Aberration.

As each pair of stars, with two exceptions, was observed both evening and morning, when the effect of aberration was not far from its maximum value, this series is well adapted to an investigation of that constant, if by any means the effect of the latitude variation can be eliminated. In fact this formed a part of the original plan in arranging the scheme of observation.

Unfortunately, however, in a series like this, the effect of aberration cannot be separated from the latitude variation without some assumption with regard to one or the other. In the present case it has been assumed that the latter can be represented by a single periodic function, the period being fourteen months. Each observation will then give an equation of the form

$$\varphi_0 + \Delta + Ax + By + Cp + Tp = \phi$$

Where φ_0 is an assumed latitude,
Δ a constant correction,
$Ax + By$ the periodic terms,
Cp the correction on account of error in Struve's aberration constant,
Tp uniformly progressive change in the latitude.

For full details as to the process of combining and solving these equations, reference may be had to the series of 1892–93.

The resulting correction to Struve's value of the constant of aberration, which is the only term we are now concerned with, is

	$''.0027 \pm 0140$
Struve's value	$20''.4451$
Final result	$20''.448 \pm 014$

It is no doubt an open question whether this value is entitled to very great confidence as a determination of the aberration constant. If the series had been continued for three months longer, so as to embrace an entire period of fourteen months, or if it had happened to be arranged symmetrically with respect to a maximum and minimum value of the latitude, its weight would no doubt have been very materially increased.

As neither of these conditions have been met, it appears quite doubtful whether the method pursued has been entirely successful in eliminating the latitude variation.

At all events it has not been thought advisable to introduce any correction on account of aberration. The foregoing results therefore, as to latitude, depend upon Struve's value of this constant.

THIRD SERIES.

October 10, 1892, to December 27, 1893.

Before beginning this series some changes were made in the building and instrument, the most important being the following:

The width of the observing slit was increased from 20 to 36 inches. It was hoped that this might reduce the liability to disturbance in the way of irregular refraction. The instrument was fitted with two latitude levels to replace the single one before used. The latter had deteriorated to such an extent as to be worthless for refined determination of latitude. The new levels were furnished by G. Saegmüller, of Washington, and proved superior to any heretofore employed.

The Level Values.

The method of determining these, with an example illustrating the process, will be found in the publication of results for 1894, '95.* That series being a continuation of this one, no change in this particular occurred.

Six different determinations were made as follows. The upper level is called *A*, the lower *B*:

1892	September 30–October	1	*A* 1.″335	*B* 1.″006	Thermom.	62°
	December 29–December	31	1.395	1.058		24
1893	March 30–March	31	1.370	1.024		44
	June 25–June	26	1.175	0.995		67
	October 4–October	12	1.307	1.044		59
1894	January 7–January	8	1.273	1.037		36

The values employed are as follows:

1892	October	–1893	February	*A* 1.365	*B* 1.032
1893	March	–	June	1.272	1.010
	July	–	October	1.238	1.020
	November	–	December	1.286	1.040

In observing care was taken to keep the level correction small, in order to minimize the effect of any uncertainty as to the true value.

* Vol. xx, Transactions of the American Philosophical Society, Article iii.

The Micrometer.

The description of the micrometer and reticle found in the publication of results for 1894, '95, before referred to, applies equally to the present series. The methods of observing and of determining the intervals of the micrometer threads being the same in both series.

At various times transits of circumpolar stars near elongation were observed for the purpose of determining the screw value. Of these 51 Cephei and δ Ursæ Minoris were each observed at five elongations; 43 Cephei at twenty, and Groombridge 750 at fifteen elongations respectively. In comparing the results it became obvious that the effect of constant use in wearing the screw was manifest, and that the value should be treated as a variable quantity.

The method of procedure adopted, as seeming least objectionable, was to derive the screw value from the latitude observations, as will be explained presently.

The above-mentioned transits of circumpolar stars were employed for investigating the progressive errors, which were increasing with the increased wearing of the screw.

Let n be the number of revolutions of the screw reckoned from the middle of the scale—the middle in this case is revolution 20.

R the mean value of one revolution.

The errors being supposed uniformly progressive, the space s corresponding to n will have the form

$$S = Rn + \rho n^2$$

For a second reading

$$S' = Rn' + \rho n'^2$$
$$S - S' = R\,(n - n') + \rho\,(n^2 - n'^2)$$

The transits are observed from 33 to 7. The observed times are corrected for change of level and curvature of the stars' path. They are then combined by subtracting 33 from 19, 32 from 18, ... 21 from 7, thus obtaining a series of values for the time required for the star to pass over a space equal to fourteen revolutions of the screw. If no progressive or other errors were present these times should be equal. The difference between any individual value and the mean of all is taken as the correction due to the progressive error expressed in seconds of time. This must then be reduced to the equivalent in screw revolutions.

In the following tabular statement is found the mean values of these differences, those for 51 Cephei being reduced to the scale of δ Ursæ Minoris and those for 43 Cephei to Groombridge 750.

	Micrometer	$n^2 - n'^2$	*Observed dif.*	$\frac{v}{c-o}$	
			^{s}		
1	19 — 33	— 168	— 3.64	+ .53	
2	18 — 32	— 140	— 2.29	— .30	
3	17 — 31	— 112	— 2.23	+ .16	
4	16 — 30	— 84	— 1.04	— .51	51 Cephei and
5	15 — 29	— 56	— 1.24	+ .20	δ Ursæ Minoris.
6	14 — 28	— 28	— .67	+ .15	
7	13 — 27	— 0	+ .36	— .36	
8	12 — 26	+ 28	+ .88	— .36	
9	11 — 25	+ 56	+ .94	+ .10	
10	10 — 24	+ 84	+ 1.82	— .27	
11	9 — 23	+ 112	+ 2.29	— .22	
12	8 — 22	+ 140	+ 2.41	+ .18	
13	7 — 21	+ 168	+ 2.36	+ .75	
1	19 — 33	— 168	— 1.70	— .13	
2	17 — 31	— 112	— 1.34	+ .12	
3	15 — 29	— 56	— .71	+ .10	43 Cephei and
4	13 — 27	— 0	+ .20	— .20	Groombridge 750.
5	11 — 25	+ 56	+ .51	+ .10	
6	9 — 23	+ 112	+ 1.22	— .00	
7	7 — 21	+ 168	+ 1.82	+ .01	

The "observed difference" is the observed value of $\rho\ (n^2 - n'^2)$.

The time required for 51 Cephei to pass over a space equal to one revolution is $57^s.06$.

That for 750 Groombridge $40^s.92$. Therefore,

From 51 Cephei and δ Ursæ Minoris $\rho = + {}^s.01855 = + .000325\ R$

43 Cephei and 750 Groombridge $+ .01086 = + .000265\ R$

Mean $+ .000295\ R$

Which is the value employed in this series.

The corresponding corrections in terms of screw revolutions follow:

7 and	33	+.0499
8	32	.0425
9	31	.0357
10	30	.0295
11	29	.0239
12	28	.0189
13	27	.0145
14	26	.0106
15	25	.0074
16	24	.0047
17	23	.0027
18	22	.0012
19	21	.0003

A preliminary reduction of the latitude observations is now carried out, applying

these corrections to the micrometer readings and using an approximate value of the screw. The temperature coefficient deduced from the 1889, '90 series has been used. This was derived before the complication due to wearing of the screw had become noticeable and seemed reliable. The value assumed is as follows:

$$R = 50''.5194 - .000367\ [T - 45^{\circ}]$$

T being the thermometer reading.

Each latitude determination now gives an equation of the form

$$\sqrt{p}\ [\Delta\phi - (M - M')\ \Delta\tfrac{1}{2}R \quad n]$$

Where $\Delta\phi$ and ΔR are the corrections to the assumed latitude and micrometer values respectively. An example illustrating this process may be found in the published results for 1894, '95, before referred to.

Sixteen series of equations were formed for determining the values of $\Delta\phi$ and $\Delta\frac{1}{2}R$, the time embraced by each series therefore averages something less than a month.

The results for $\Delta\frac{1}{2}R$ follow. No use was made of $\Delta\phi$:

					$\Delta\frac{1}{2}R$	*Adjusted* $\Delta\frac{1}{2}R$	*c–o*
1	1892	October	10–October	24	— .0111	— .0088	+ 23
2		October	30–November	26	— .0090	— .0056	+ 34
3		December	1–December	23	+ .0029	— .0024	— 53
4		December	26–January	20	+ .0017	+ .0009	— 08
5	1893	January	21–February	16	— .0001	+ .0041	+ 42
6		February	20–March	18	+ .0100	+ .0073	— 27
7		March	18–April	4	+ .0131	+ .0106	— 25
8		April	16–May	7	+ .0124	+ .0138	+ 14
9		May	8–June	8	+ .0209	+ .0170	— 39
10		June	8–June	30	+ .0216	+ .0203	— 13
11		July	2–July	23	+ .0205	+ .0242	+ 37
12		July	27–August	10	+ .0244	+ .0288	+ 44
13		September	2–September	23	+ .0336	+ .0337	+ 01
14		September	27–October	24	+ .0366	+ .0381	+ 15
15		October	25–November	30	+ .0461	+ .0425	— 36
16		December	4–December	27	+ .0484	+ .0470	— 14

The adjustment was graphic and, as will be seen, the increase in $\Delta\frac{1}{2}R$ differs but little from the linear form.

The micrometer frame carried five threads numbered consecutively. The respective distances were made as nearly as possible equal to ten revolutions of the screw. In observing a latitude pair the bisection was made with thread III, unless the difference of

zenith distance was as great as twenty revolutions. In such cases threads II and IV were used to avoid the large number of turns of the screw.

The distance between II and IV was therefore required with accuracy and was determined at frequent intervals. Below will be found the amount to be added to the micrometer correction required on account of the amount by which II–IV differed from twenty revolutions. The progressive diminution is evidently due mainly to the increased value of R from wearing:

1892	October	10	+ 1.54	1893	February	24	+ 0.83
	October	14–November 17	+ 1.25		"	25	+ 0.82
	November	20	+ 1.20		February	26–July 21	+ 0.81
	"	22	+ 1.16		July	23	+ 0.77
	"	26	+ 1.11		"	27–August 10	+ 0.74
	December	1–December 11	+ 1.05		September	2–September 22	+ 0.55
	"	2	+ 1.01		"	23	+ 0.48
	"	12	+ 0.97		"	27–October 24	+ 0.42
	"	15	+ 0.91		October	25	+ 0.36
	"	17	+ 0.90		"	28	+ 0.31
	December	18–February 15	+ 0.86		October	29–November 16	+ 0.25
1893	February	16	+ 0.85		November	26	+ 0.16
	"	20	+ 0.84		"	28–December 25	+ 0.06

The Star List.

The list of stars found in the following pages shows the values of the coordinates for 1892, '93 actually employed in the latitude reduction. The Right Ascensions differ slightly from the definitive values, but this is of no importance for present purposes. The last column, headed "correction for curvature," is the only one which appears to call for explanation. This is the sum of the values of the quantity

$$\tfrac{1}{4}\,(15\ \mathrm{T})^2 \sin 1'' \tan \delta$$

Computed for each star of the pair, T being the interval from the time of bisection to the time of passing the meridian.

The reduction to apparent place was made by the formula

$$\tfrac{1}{2}\,(\delta + \delta') = \tfrac{1}{2}\,(\delta_0 + \delta'_0) + \tfrac{1}{2}\,(\mu' + \mu_1')\,\tau + \tfrac{1}{2}\,(a' + a_1')\,A + \tfrac{1}{2}\,(b' + b_1')\,B + \tfrac{1}{2}\,(c' + c_1')\,C + \tfrac{1}{2}\,(d' + d_1')\,D$$

A, B, C and D being taken from the American Ephemeris.

Group	No.	B.A.C.	α1892	α1893	δ1892	δ1893	μ'	Cor. for Curvature
			h m s	s	° ′ ″	″	″	″
	1	6599	19 12 37.11	39.19	37 56 29.82	36.09	+.0140	+.06
		6656	19 20 31.77	33.66	43 10 39.27	46.13	—.0362	
	2	6697	19 26 58.91	60.43	51 29 59.15	66.71	+.1250	+.06
		6740	19 35 6.55	8.92	29 54 16.46	24.59	+.0468	
	3	6784	19 42 19.52	21.80	33 28 35.54	43.76	—.4397	+.06
		6830	19 48 56.15	57.91	47 39 11.19	20.36	—.0070	
	4	6876	19 55 56.84	58.72	45 28 39.28	48.98	—.0197	+.06
		6915	20 2 20.99	23.21	35 40 30.41	40.19	—.4269	
	5	6962	20 9 54.36	56.24	46 29 20.22	30.97	—.0141	+.06
I		6998	20 14 30.25	32.55	34 38 43.57	54.69	+.0108	
	6	7037	20 19 37.34	37.64	68 32 5.31	16.82	+.0330	+.09
		7094	20 28 50.50	53.33	12 39 26.94	39.10	+.0388	
	7	7140	20 33 41.82	44.50	20 49 20.54	33.01	+.0112	+.07
		7176	20 38 0 22	1.50	60 6 52.81	65.73	+.1673	
	8	7213	20 43 12.08	14.42	36 5 38.18	51.29	+.0026	+.06
		7254	20 49 32.09	34.19	44 46 21,49	35.00	—.0053	
	9	7297	20 55 47.26	49.53	39 49 52.35	66.47	+.2072	+.06
		7326	20 59 49.46	51.70	41 12 4.03	18.15	—.0476	
	10	7380	21 10 25.51	28 51	4 48 5.56	20.29	—.0764	+.13
		7438	21 16 52.56	52.00	76 33 26.80	41.99	+.0105	
	1	7509	21 28 55.90	55.70	75 55 43.89	59.74	—.0107	+.13
		7522	21 33 7.28	10.29	5 17 4.32	20.42	+.0308	
	2	7561	21 38 52.92	55.86	9 22 47.99	64.37	+.0093	+.10
		7597	21 41 44.91	45.66	71 49 30.18	46.65	—.0433	
	3	BD59.2444	21 55 55.16	57.05	59 46 48.32	65.51	+.0044	+.07
		7712	22 2 46.01	48.83	21 10 38.09	55.51	—.0655	
	4	7760	22 8 10.99	12.38	69 35 56.13	73.85	+.0075	+.10
		7796	22 16 12.09	15.04	11 39 40.03	58.08	+.0166	
II	5	7820	22 20 8.05	10.47	48 55 43.77	61.94	—.0133	+.06
		7843	22 25 5.39	8.13	32 1 11.56	29.91	—.0058	
	6	7915	22 36 38.55	41.23	39 39 40.80	59.54	—.0029	+.05
		7932	22 39 16.47	19.14	41 15 9.05	27.88	+.0148	
	7	7962	22 45 29.46	32.16	41 22 53.38	72.37	—.0061	+.05
		7978	22 48 15.14	17.88	39 35 36.42	55.48	—.0121	
	8	8024	22 56 56.72	59.25	56 31 31.05	50.34	—.0064	+.07
		8052	23 1 51.11	54.03	24 53 7.44	26.82	—.0279	
	9	8078	23 6 17.05	20.09	8 8 1.20	20.71	+.0139	+.12
		8122	23 13 59.14	61.32	73 5 55.02	74.64	—.0321	

Group	*No.*	*B.A.C.*	*α1892*	*α1893*	*δ1892*	*δ1893*	*μ'*	*Cor. for Curvature*
			h m s	s	° ′ ″	″	″	″
	1	8195	23 25 58.63	61.57	38 38 34.70	54.46	— .0731	+ .06
		8229	23 32 50.27	53.20	42 40 12.61	32.53	+ .0026	
	2	8252	23 37 49.95	52.85	52 33 12.23	32.18	— .0042	+ .07
		8284	23 44 11.40	14.43	28 14 28.17	48.20	+ .0194	
	3	8317	23 50 8.99	11.97	56 48 39.88	59.91	— .0108	+ .07
		8324	23 52 15.33	18.38	24 32 27.64	47.65	— .0258	
	4	16	0 4 42.50	45.60	45 28 16.31	36.35	— .0054	+ .06
		LL 220	0 11 5.32	8.44	35 53 22.91	42.98	+ .0501	
III	5	99	0 22 21.14	24.25	18 55 0.51	20.46	— .0090	+ .07
		126	0 26 51.69	55.06	62 20 8.36	28.27	— .0050	
	6	194	0 38 30.94	34.80	74 23 51.48	71.22	— .0307	+ .13
		222	0 43 4.70	7.81	6 59 49.90	69.57	— .0349	
	7	259	0 50 45.48	48.79	37 54 48.37	67.97	+ .0380	+ .06
		318	1 1 48.74	52.11	43 21 59.45	78.72	— .0602	
	8	394	1 13 52.52	56 47	64 5 29.61	48.60	— .0293	+ .08
		413	1 18 2.58	5.79	17 15 19.22	38.09	— .0307	
	9	438	1 23 11.69	16.07	69 42 30.97	49.64	— .0748	+ .10
		459	1 26 49.53	52.70	11 19 36.81	55.45	+ .0061	
	10	480	1 30 27.54	31.04	40 51 54 15	72.29	— .3709	+ .05
		502	1 34 12.29	15.81	40 1 47.50	65.86	— .0217	
	1	592	1 51 26.96	30.23	17 17 24.20	41.91	— .0171	+ .08
		611	1 55 0.62	4.97	63 52 5.06	22.64	+ .0010	
	2	656	2 3 7.04	10.60	34 28 34.28	51.47	— .0355	+ .06
		706	2 12 18.73	22.58	46 52 52.50	69.28	— .0143	
	3	744	2 20 9.88	14.74	66 54 59.22	75.64	+ .0074	+ .09
		780	2 26 59.28	62.58	14 33 21.82	37.92	+ .0402	
	4	816	2 35 19.25	23.51	54 38 40.29	55.88	— .0286	+ .06
		872	2 43 37.57	41.06	26 48 54.19	69.24	— .1028	
IV	5	916	2 52 41.97	45.84	40 36 7.48	22.06	— .0405	+ .05
		963	3 1 8.46	12.35	40 32 20.98	35.09	+ .0045	
	6	981	3 4 19.01	22.86	39 12 3.23	17.15	+ .0083	+ .06
		993	3 7 46.58	50.54	42 5 59.41	73.12	+ .0164	
	7	1050	3 19 7.72	13.83	71 29 12.68	25.63	+ .0046	+ .10
		1068	3 21 18.96	22.21	9 21 20.54	33.31	— .0366	
	8	1119	3 33 19.21	22.60	16 11 5.84	17.78	— .0304	+ .08
		1144	3 39 38.08	43.51	65 11 28.97	40.48	— .0130	
	9	1221	3 50 29.11	32.65	22 9 59.06	69.69	— .1052	+ .07
		1237	3 55 27.20	32.17	58 51 17.12	27.49	— .0006	
	10	1274	4 2 52.42	55.89	19 19 23.33	33.10	— .0342	+ .07
		1286	4 7 22.56	27.81	61 34 40.44	49.89	— .0136	

Group	No.	B.A.C.	α1892	α1893	δ1892	δ1893	μ'	Cor. for Curvature
			h m s	s	° ′ ″	″	″	″
	1	1307	4 11 6.79	11.28	49 47 5.09	14.19	—.0623	+.06
		1364	4 19 13.64	17.44	31 11 40.53	48.95	—.1161	
	2	1425	4 31 24.38	29.08	52 51 49.02	56.56	—.0166	+.06
		1444	4 34 34.07	37.82	28 24 18.46	25.73	—.0298	
	3	1486	4 43 58.61	61.86	6 46 20.17	26.73	+.0345	+.13
		1496	4 48 38.09	45.64	74 6 3.77	9.94	+.0298	
	4	1536	4 53 48.72	54.04	60 17 0.84	6.53	—.0140	+.07
		1555	4 57 55.41	58.98	21 7 33.24	38.61	—.0156	
V	5	1583	5 3 28.20	33.76	62 33 25.88	30.78	+.0079	+.08
		1625	5 10 25.17	28.68	18 19 6.68	10.98	—.0040	
	6	1687	5 19 20.25	23.47	6 15 4.80	8.33	—.0079	+.13
		1706	5 25 17.56	25.56	74 58 15.89	18.92	+.0124	
	7	1751	5 31 36.98	43.00	65 38 16.94	19.38	—.0337	+.08
		1821	5 40 32.85	36.30	15 46 46.91	48.61	+.0011	
	8	1862	5 46 14.17	17.58	14 8 37.52	38.72	+.0018	+.07
		1874	5 49 36.39	42.61	67 0 8.42	9.28	—.0457	
	9	1923	5 55 30.73	35.07	42 54 50.85	51.09	—.1487	+.06
		1942	5 59 8.43	12.56	38 29 30.37	30.40	—.0420	
	10	1970	6 3 1.66	5 28	22 12 24.54	24.28	+.0008	+.07
		2007	6 10 5.68	10.98	59 2 57.07	56.21	+.0271	
	1	2045	6 17 23.08	28.32	58 28 31.30	29.77	—.0072	+.07
		2101	6 23 50.59	54.22	22 36 58.11	56.03	+.0021	
	2	2139	6 29 7.32	11.45	38 31 55.12	52.55	—.0215	+.06
		2159	6 31 37.08	41.37	42 34 59.54	56.72	—.0594	
	3	2187	6 36 41.49	46.80	59 32 60.42	57.21	—.0037	+.07
		2233	6 45 4.71	8.31	21 53 16.82	12.87	—.0298	
	4	2301	6 56 38.42	42.23	29 30 63.76	58.04	—.8112	+.06
		2341	7 4 58.07	62.77	51 36 25.36	19.75	+.0048	
	5	2365	7 9 16.43	21.63	59 6 33.96	27.96	—.0243	+.07
		2410	7 13 40.40	43.98	22 10 50.49	44.15	—.0056	
VI	6	2429	7 19 38.58	44.88	68 41 7.27	0.39	—.0479	+.09
		2473	7 23 47.11	50.45	12 13 45.77	38.58	—.0099	
	7	2488	7 28 41.21	45.58	46 25 4.24	56.67	—.0091	+.06
		2509	7 32 6.98	10.91	34 49 52.83	44.85	—.1296	
	8	2551	7 37 55.68	59.30	24 39 23.26	14.89	—.0515	+.07
		2616	7 47 41.48	46.38	56 47 15.51	6.40	—.0231	
	9	2676	7 57 27.90	31.44	22 22 22.99	13.15	+.0018	+.07
		2704	8 1 12.06	17.02	58 33 49.44	39.24	—.0786	
	10	2786	8 13 30.36	34.02	27 33 61.13	49.72	—.3769	+.06
		2792	8 15 37.89	42.44	53 33 61.09	49.80	—.0999	
	11	2819	8 21 17.52	22.55	61 4 43.03	31.32	—.1155	+.07
		2880	8 29 6.95	10.40	17 57 40.05	27.90	—.0000	
	12	2953	8 38 32.92	36.32	18 32 63.20	50.17	—.2303	+.07
		2982	8 44 28.52	33.52	62 21 56.76	43.59	+.0237	

Group	*No.*	*B.A.C.*	*α1892*	*α1893*	*δ1892*	*δ1893*	*μ'*	*Cor. for Curvature*
			h m s	s	° ′ ″	″	″	″
	1	3008	8 47 21.66	26.87	65 0 59.45	45.98	—.0886	+.08
		3052	8 51 33.31	36.66	15 59 44.39	30.78	+.0371	
	2	3083	8 57 42.81	47.06	51 14 73.52	59.40	—.0793	+.06
		3109	9 1 31.02	34.64	30 5 17.00	2.73	+.0062	
	3	3140	9 8 24.95	29.30	54 27 63.03	48.40	+.0646	+.06
		3170	9 12 56.43	59.95	26 42 23.87	8.90	—.0167	
	4	3228	9 22 44.10	47.29	8 39 33.31	17.79	—.0093	+.11
		3231	9 24 41.72	47.49	72 40 64.52	48.82	—.0743	
VII	5	3281	9 31 37.20	40.96	40 43 27.75	11.76	+.0113	+.05
		3307	9 35 18.87	22.60	40 14 59.27	43.04	—.0402	
	6	3375	9 47 10.62	14.21	35 29 31.01	14.23	—.0030	+.06
		3397	9 51 8.04	11.85	45 55 42.80	25.79	—.0440	
	7	3468	10 4 48.70	52.27	37 55 61.21	43.60	—.0340	+.06
		3505	10 10 34.96	38.60	43 26 72.44	54.59	—.0372	
	8	3530	10 15 45.41	48.99	41 46 38.74	20.58	—.1403	+.05
		3584	10 23 48.23	51.75	39 28 39.79	21.48	+.0024	
	9	3647	10 34 34.61	38.76	66 16 55.04	36.29	—.0752	+.09
		3698	10 40 42.05	45.24	14 45 53.32	34.40	—.0516	
	10	3725	10 47 2.00	5.66	55 9 32.62	13.57	—.0186	+.06
		3751	10 50 42.75	46.01	26 4 36.19	17.04	—.0090	
	1	3787	10 59 29.74	32.94	25 46 70.21	50.79	—.0596	+.06
		3825	11 6 27.39	30.92	55 28 51.77	32.25	—.0097	
	2	3877	11 18 17.62	20.75	11 7 26.63	6.83	—.0734	+.10
		3914	11 24 59.24	62.86	69 55 37.48	17.64	—.0239	
	3	3949	11 32 2.45	5.78	51 12 59.99	40.05	—.0348	+.06
		LL 22186	11 38 28.65	31.79	30 10 46.23	26.29	+.0166	
	4	4010	11 46 45.40	48.88	38 29 36.80	11.01	—5.7721	+.05
		W.B. 956	11 50 47.81	50.93	42 36 52.84	32.79	—.0091	
VIII	5	4074	12 0 12.31	15.38	63 31 71.28	51.15	—.0818	+.08
		4099	12 5 1.35	4.41	17 24 37.09	17.05	+.0070	
	6	4123	12 10 4.89	7.88	57 37 57.70	37.67	+.0024	+.07
		4141	12 13 51.93	54.97	23 37 64.65	44.63	—.0108	
	7	4195	12 21 33.29	36.28	28 51 67.68	47.64	—.0803	+.06
		4217	12 24 56.58	59.44	52 7 53.87	33.94	+.0032	
	8	4239	12 28 52.41	55.00	70 22 60.87	40.98	+.0069	+.10
		4271	12 36 25.13	28.16	10 49 50.92	31.02	—.0969	
	9	4300	12 42 42.11	44.69	63 21 74.17	54.45	—.0102	+.08
		4318	12 46 50.06	53.04	17 39 41.16	21.52	—.0043	
	10	4371	12 57 34.17	36.56	64 11 25.35	5.94	+.0109	+.08
		4403	13 4 29.33	32.28	17 25 29.05	9.79	+.0011	
	11	4433	13 8 49.16	51.89	40 43 29.10	9.96	+.0093	+.05
		4467	13 15 28.61	31.30	40 42 63.06	44.07	—.0135	

Group	No.	B.A.C.	α1892	α1893	δ1892	δ1893	μ′	Cor. for Curvature
			h m s	s	° ′ ″	″	″	″
	1	4510	13 24 29.23	31.44	60 29 72.98	54.30	+ .0240	+ .07
		4562	13 35 30.91	33.77	20 29 67.51	49.20	+ .0277	
	2	4694	14 1 38.79	41.44	31 21 57.84	40.45	— .0994	+ .06
		4701	14 4 15.20	17.45	49 57 66.69	49.57	+ .0504	
	3	4728	14 10 2.28	4.71	42 1 33.37	16.36	— .1011	+ .06
		4758	14 15 21.60	24.07	39 17 25.80	9.15	— .0024	
IX	4	4825	14 30 13.64	16.10	37 5 61.91	45.96	— .0536	+ .06
		4841	14 34 9.18	11.44	44 6 29.04	13.39	+ .0293	
	5	4874	14 39 21.71	23.20	61 43 20.20	4.77	— .0323	+ .07
		4905	14 46 24.51	27.26	19 32 57.37	42.29	— .0803	
	6	4926	14 51 7.40	10.23	14 52 58.86	44.14	— .0009	+ .09
		4949	14 55 52.14	53.09	66 21 45.20	30.79	+ .0170	
	7	4974	15 0 13.80	15.78	48 4 30.32	16.19	+ .0361	+ .06
		5000	15 6 16.30	18.72	33 29 17.10	3.32	— .0023	
	1	5072	15 17 29.11	31.51	33 19 13.36	0.31	+ .0104	+ .06
		5113	15 25 57.02	58.93	48 4 63.10	50.61	— .0050	
	2	5147	15 29 24.74	25.57	64 34 19.26	7.10	+ .0806	+ .08
		5180	15 36 1.11	3.86	16 22 23.64	11.85	— .0093	
	3	5210	15 39 54.69	56.34	52 41 66.78	55.31	+ .0352	+ .06
		5236	15 44 7.40	9.87	28 29 17,86	6.65	+ .0011	
	4	5271	15 48 56.38	58.45	42 45 14.01	3.79	+ .6288	+ .07
		5295	15 51 51.84	54.02	38 15 32.77	22.22	+ .0844	
X	5	BD72.703	15 56 44.08	43.46	72 41 62.83	52.58	+ .0179	+ .11
		5366	16 3 15.61	18.50	8 49 18.19	8.42	— .0015	
	6	5466	16 17 9.33	11.98	19 24 25.18	16.52	+ .0463	+ .07
		5512	16 22 31.87	32.68	61 45 31.30	23.08	+ .0554	
	7	5568	16 33 2.08	3.83	46 49 55.35	47.93	+ .0082	+ .06
		5619	16 39 52.82	55.04	34 14 17.25	10.46	+ .0709	
	8	5658	16 44 38.54	39.78	55 35 64.75	58.27	— .0066	+ .06
		5703	16 50 36.89	39.35	25 54 18.03	12.04	— .0109	
	9	5752	16 57 22.74	23.84	56 50 49.64	44.26	+ .0306	+ .07
		5786	17 4 5.61	8.08	24 37 39.16	34.28	— .0421	
	10	5842	17 13 20.06	22.27	33 12 59.99	55.94	+ .0035	+ .06
		5911	17 23 52.40	53.99	48 20 62.87	59.71	— .0149	

Group	*No.*	*B.A.C.*	*α1892*	*α1893*	*δ1892*	*δ1893*	*μ'*	*Cor. for Curvature*
			h m s	s	° ′ ″	″	″	″
	1	5941	17 29 55.26	58.05	12 38 20.16	17.31	— .2256	+ .10
		6006	17 37 35.10	34.74	68 48 28.08	26.44	+ .3151	
	2	6123	17 57 3.41	2.37	72 0 54.91	54.64	— .0078	+ .11
		6143	18 2 13.74	16.58	9 32 55.88	56.18	+ .0969	
	3	6193	18 9 28.61	30.61	38 44 36.44	37.28	+- .0043	+- .06
		6203	18 12 17.07	18.92	42 7 21.62	22.70	+- .0024	
XI	4	6232	18 15 42.19	44.51	29 37 10.65	12.03	+ .0102	+- .06
		6258	18 18 57.06	58.47	51 14 55.90	57.54	— .0122	
	5	6300	18 25 7.06	9.55	23 47 40.74	42.95	+- .0137	+- .07
		6348	18 30 42.63	43.66	56 57 46.84	49.51	— .0137	
	6	6373	18 37 5.70	6.42	60 36 38.58	41.86	+ .0451	+- .07
		6387	18 41 0.90	3.48	20 26 35.68	38.91	— .3341	
	7	6476	18 51 56.27	57.85	48 43 27.97	32.35	— .1240	+ .06
		6491	18 54 54.24	56.48	82 32 29.85	34.61	+- .0029	
	8	6534	19 0 50.89	53.17	31 34 59.88	65.07	— .0706	+- .06
		6579	19 9 17.51	19.08	49 39 8.10	14.69	+- .6214	

The Latitude Observations.

The details of the latitude determination are given in the pages following. The expression for the latitude is as follows:

$$\phi = \tfrac{1}{2}(\delta + \delta') + \tfrac{1}{2}R(M - M') + \tfrac{1}{4}d[(n - n') - (s' - s)] + (m + m') + \tfrac{1}{2}(r - r')$$

M and M' are the micrometer readings.

n, s, n', s', the readings of the north and south ends of the levels for the two stars.

m and m', the correction for curvature.

r and r', the corrections for refraction.

The columns which seem to call for explanation are as follows:

Column P gives the position of the instrument.

D, Direct. The telescope east when pointed south of the zenith.

R, Reverse. The telescope west when pointed south of the zenith.

C, The correction on account of progressive errors of the screw.

Levels *A* and B, the value of $(n-n') - (s'-s)$ for each level.

Columnn δ gives the sum of the corrections for $\Delta\frac{1}{2}R$ given on page 322 with that for curvature found in the last column of the star list.

In case of those pairs observed with threads II and IV the correction given on page 323 is included.

Column Δ gives the reduction on account of the adopted value of the Constant of Aberration, to be explained later.

Throughout this table the footnote references *a*, *b*, *c* and *d* indicate as follows: *a* = c. c. f.; *b* = definition very poor; *c* = levels discordant; *d* = clouds.

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Oct. 10	I 4	D	18.4877	22.1190	+ 6	+ .9	— .6	40 34 51.52	+ 1 31.73	+ 3	+ 8	+ 3	40 36 23.39	+9	54.2
	6		20.0707	20.9057	+ 3	— .4	+ .8	40 36 2.20	+ 21.10	+ 8	+ 3	+ 1	23.42	+8	
	8		32.6067iv	8.7467ii	+ 16	+1.1	+ .6	40 26 18.72	+10 2.70	+1.39	+ 26	+ 17	23.24	+9	53.6
	10		14.7310	25.8190	+ 16	+ .2	+ .3	40 41 2.85	— 4 40.10	+ 23	+ 7	—12	23.93	+7	
	II 1		22.1520	21.4243	+ 9	—1.1	—2.0	40 36 41.56	— 18.40	+ 14	— 45	— 1	22.84	+7	
	V 4	D	39.6377	15.4283	+211	— .4	—1.3	40 42 23.42	— 5 59.47	+ 20	— 24	—11	23.80	—2	41.6
	5		7.5773ii	31.3813iv	— 15	—1.1	—2.7	40 26 22.10	+10 1.26	+1.41	— 54	+20	24.43	—2	
	6		21.6360	22.5233	+ 11	—1.6	—1.2	40 36 45.48	— 22.44	+ 14	— 43	— 1	22.74	—2	
	7		28.0750iv	13.3790ii	+ 63	— .5	— .4	40 42 35.83	— 6 11.39	—1.33	— 13	—13	22.85	—2	
	8		22.2050	18.5667	+ 9	—2.0	—1.0	40 34 26.13	+ 1 57.18	+ 4	— 47	+ 4	22.92	—3	
	9		28.5293	14.6763	+131	+1.7	+2.4	40 42 12.48	— 5 50.27	+ 18	+ 60	—10	22.89	—3	
	10		18.6760	21.8100	+ 5	—1.0	—1.8	40 37 42.44	— 1 19.18	+ 10	— 40	— 3	22.93	—3	
	VI 1		15.4673	24.0997	— 12	—1.1	—2.2	40 32 45.46	+ 3 38.02	— 1	— 47	+ 7	23.07	—3	
	3		26.8063	10.8113	—113	—1.4	—2.8	40 43 8.08	— 6 43.75	+ 21	— 60	—13	23.81	—3	43.0
	4		23.6200	17.2347	+ 15	—1.3	—1.4	40 33 42.31	+ 2 41.33	— 0	— 40	+ 5	23.29	—3	43.0
Oct. 11	6		8.0673ii	29.3600iv	— 9	—1.2	—1.4	40 27 24.03	+ 8 57.83	+1.44	— 38	+19	23.11	—3	42.1
	I 1	D	24.4017	18.3080	+ 49	+ .1	— .2	40 33 49.21	+ 2 34.10	+ 1	— 1	+ 4	23.35	+9	60.3
	2		27.3083	13.0777	+ 17	+ .1	— .7	40 42 23.07	— 5 59.47	+ 19	— 7	—10	23.62	+9	
	3		25.4633	20.1743	+ 87	— .7	— .6	40 34 9.34	+ 2 13.80	+ 1	— 19	+ 4	23.00	+9	60.3
	4		18.3310	21.9413	+ 2	+1.3	+1.8	40 34 51.60	+ 1 31.19	+ 3	+ 45	+ 3	23.30	+9	60.3
	5		19.1520	24.0120	+ 44	+1.8	+2.3	40 34 19.43	+ 2 3.62	+ 2	+ 60	+ 3	23.70	+9	
	6		19.6553	20.4610	— 1	— .1	+ .1	40 36 2.29	+ 20.35	+ 8	0	+ 1	22.73	+8	
	7		30.9173iv	12.0160ii	— 9	— .6	—1.4	40 28 24.37	+ 7 57.37	+1.15	— 28	+15	22.76	+8	
	8		32.1103iv	8.2270ii	+ 3	—1.2	—1.0	40 26 18.85	+10 3.23	+ 1.10	— 33	+ 17	23.02	+9	58.5
	9		28.4277	16.3310	+ 168	—1.1	— .2	40 31 17.76	+ 5 5.94	— 5	— 21	+ 8	23.52	+9	
	II 1		21.7453	21.0133	+ 6	—1.8	—2.6	40 36 41.72	— 17.75	+ 14	— 64	— 1	23.46	+7	57.2
	2		19.5307	19.7467	0	+2.1	+2.6	40 36 27.53	— 5.46	+ 10	+ 69	0	22.86	+7	
	3		14.0190	31.4287	+280	— .9	—2.0	40 29 03.56	+ 7 20.42	— 8	— 41	+ 14	23.63	+8	
	V 5	R	36.2087iv	12.4557ii	+ 95	—1.6	—2.9	40 26 22.19	+10 0.21	+1.12	— 65	+20	23.07	—2	49.0
	6		21.9283	21.0837	+ 7	—3.6	—3.6	40 36 45.54	— 21.38	+ 14	—1.08	— 1	23.21	—2	
	7		14.9223	29.6697	+198	—1.8	—1.0	40 42 35.89	— 6 13.01	+ 21	— 43	—13	22.53	—2	
	8		21.5097	26.1500	+ 105	—2.7	—1.8	40 34 26.16	+ 1 57.48	+ 4	— 69	+ 4	23.03	—3	
	9		14.2300	28.0500	+ 92	—1.5	—1.8	40 42 12.51	— 5 49.31	+ 18	— 31	—10	22.97	—3	48.9
	10		22.3913	19.2800	+ 16	— .7	—1.0	40 37 42.46	— 1 18.71	+ 10	— 25	— 3	23.57	—3	
	VI 1		26.7120	18.0737	+122	—1.7	—2.2	40 32 45.46	+ 3 38.50	— 1	— 57	+ 7	23.45	—3	
	3		14.4247	30.4120	+228	—2.6	— .6	40 43 8.05	— 6 44.40	+ 21	— 52	—13	23.21	—3	
Oct. 14	4		17.9813	24.3747	+ 46	— .7	—1.0	40 33 42.26	+ 2 41.61	— 0	— 25	+ 5	23.67	—3	
	I 2	R	15.1283	29.3763	+190	—1.4	—1.4	40 42 23.05	— 6 0.33	+ 19	— 42	—10	22.39	+9	64.4
	3		19.5710	21.8563	+ 68	+ .5	—1.1	40 34 9.38	+ 2 13.66	+ 1	— 5	+ 4	23.04	+9	
	4		24.0647	20.4537	+ 49	— .5	—1.0	40 34 51.68	+ 1 31.32	+ 3	— 21	+ 3	22.85	+9	63.5
	5		23.8753	18.9813	+ 42	— .1	+ .3	40 34 19.56	+ 2 3.71	+ 2	+ 3	+ 3	23.35	+9	
	6		20.6190	19.7977	+ 1	—1.0	—1.5	40 36 2.46	+ 20.75	+ 8	— 36	+ 1	22.94	+8	62.6
	7		12.6413ii	31.5407iv	— 17	+ .1	— .5	40 28 24.58	+ 7 57.29	+1.15	— 5	+15	23.12	+9	
	8		10.9820ii	34.8677iv	+ 68	— .1	—1.7	40 26 19.11	+10 3.43	+1.10	— 23	+17	23.58	+9	
	9		15.0763	27.1530	+ 80	+ .4	+1.4	40 31 18.06	+ 5 5.22	— 5	+ 25	+ 8	23.56	+9	
	10		28.1250	17.0760	+169	— .4	—1.0	40 41 3.32	— 4 39.48	+ 23	— 20	—12	23.75	+7	61.9
	II 1		23.7493	24.4720	+ 19	—3.2	—3.5	40 36 42.08	— 18.30	+ 14	— 99	— 1	22.92	+7	
	2		22.0410	21.8627	+ 2	—1.3	—1.7	40 36 27.94	— 4.51	+ 10	— 44	0	23.09	+7	
	3		30.8350	13.4327	+219	—2.7	—3.6	40 29 4.05	+ 7 20.07	— 8	— 92	+14	23.26	+8	60.2
	V 1	D	14.2197	30.5180	+ 226	—5.3	—7.6	40 29 32.45	+ 6 52.24	— 8	—1.88	+12	22.85	—1	51.2
	3		30.8323iv	6.9977ii	— 24	— .5	—1.2	40 26 19 92	+10 1.96	+1.17	— 24	+24	23.05	—1	
	4		27.4323	13.1690	+ 26	+ .4	+ .3	40 42 23.91	— 6 0.33	+ 20	+ 11	—11	23.78	—2	
	6		20.7950	21.6730	+ 8	—3.6	—4.2	40 36 45.81	— 22.20	+ 14	—1.15	— 1	22.59	—2	51.3
	7		27.7513	12.9723	+ 31	+ .5	— .2	40 42 36.14	— 6 13.38	+ 21	+ 6	—13	22.90	—2	
	8		21.6333	16.9660	— 19	—1 5	—2.6	40 31 26.37	+ 1 57.84	+ 4	— 59	+ 4	23.70	—3	

1892	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
Oct. 14	V 9		27.9637	14.1773	| 87	—1.7	- -3.1	40 42 12.69	— 5 48.44	| 18	— 69	—10	40 36 23.64	—3	50.6
	VI 1		17.7610	26.3807	+105	—1.0	—1.9	40 32 45.56	|- 3 37.99	— 1	— 41	|- 7	23.20	—3	50.6
	2		24.7813	17.7893	-|- 54	— .7	—1.5	40 33 27.18	. 2 56.74	— 0	- 31	| 5	23.66	—3	
	3		29.6873	13.7040	-|-160	— .7	—2.0	40 43 8.07	— 6 44.12	-|- 21	— 38	—13	23.65	—3	
	4		24.1997	17.8227	-|- 38	— .5	—1.5	40 33 42.19	-|- 2 41.17	— 0	— 28	| 5	23.13	—3	50.1
	6		10.2540[ii]	31.5587[iv]	-|- 7	—1.2	—2.0	40 27 23.83	+ 8 58.15	-| 1.15	— 46	| 19	22.86	—3	50.0
Oct.	7		22.3697	19.9860	|- 17	—2.2	—2.5	40 37 24.48	— 1 0.25	| 8	— 70	— 2	23.59	—3	
16	V 1	R	30.5960	14.4027	| 239	-| 1.9	|-2.0	40 29 32.77	|- 6 49.62	— 8	| 58	-|-12	23.01	—1	54.9
	2		20.1663	24.5160	| 60	-|-1.6	-|-1.6	40 38 12.43	— 1 50.01	| 10	| 48	— 3	22.97	—1	
	3		12.9690[ii]	36.7973[iv]	| 110	— .2	— .4	40 26 20.16	|-10 . 2.13	-| 1.17	— 8	| 24	23.62	—1	53.5
	4		14.9007	29.1510	|-170	—1.3	—1.3	40 42 21.16	— 6 0.44	-|- 20	— 39	—11	23.42	—2	
	5		31.7520[iv]	8.0120[ii]	— 2	—2.8	—1.7	40 26 22.77	|- 9 59.62	|-1.12	— 69	-|-20	23.02	—2	
	6		23.4453	22.5627	-|- 17	—1.4	—1.6	40 36 45.99	— 22.34	-|- 14	— 44	— 1	23.34	—2	
	7		15.3547	30.0787	| 236	—1.2	—3.0	40 42 36.31	— 6 12.50	-|- 21	— 59	—13	23.30	—2	
	8		19.8340	24.4710	-|- 60	— .8	—1.7	40 34 26.51	| 1 57.27	-|- 4	— 35	-|- 4	23.51	—2	
	9		14.4910	28.2893	| 114	—2.2	—2.8	40 42 12.81	— 5 48.81	-|- 18	— 73	—10	23.38	—2	52.0
	10		23.7823	20.6587	-|- 41	—1.4	— .9	40 37 42.71	— 1 19.00	| 10	— 35	— 3	23.43	—3	
	VI 1		25.7637	17.1567	-|- 73	—2.1	— .3	40 32 45.65	| 3 37.58	— 1	— 40	-|- 7	22.89	—3	
	2		18.7787	25.7830	| 95	—1.8	—2.4	40 33 27.25	-|- 2 57.16	— 0	— 61	-|- 5	23.85	—3	
	3		14.0270	30.0167	| 191	—1.8	—1.6	40 43 8.12	— 6 44.36	|- 21	— 51	—13	23.33	—3	52.3
	4		17.4323	23.8193	-|- 22	—1.0	—1.8	40 33 42.20	-|- 2 41.38	— 0	— 40	| 5	23.23	—3	
	5		17.8507	23.2523	|- 18	—2.2	— .9	40 38 39.66	— 2 16.48	|- 12	— 49	— 4	22.77	—3	
	6		31.4320[iv]	10.1017[ii]	| 6	—1.9	—2.0	40 27 23.79	| 8 58.78	| 1.15	— 58	-|-19	23.33	—3	
	7		20.8750	23.2430	-|- 29	—2.7	—2.8	40 37 21.42	— 59.89	-|- 8	— 82	— 2	23.77	—3	
	8		31.5090	15.2487	| 325	— .9	—1.5	40 43 14.72	— 6 51.53	|- 21	— 35	—12	22.93	—3	"
Oct. 19	I 1	D	25.2527	19.1507	|- 79	—1.5	— .3	40 33 48.82	. 2 34.32	. 1	— 29	-|- 4	22.90	-| 9	61.9
	2		27.1397	12.8927	0	|- .1	- .2	40 42 22.83	— 5 59.81	-|- 19	— 1	—10	23.07	| 9	
	3		23.3527	18.0270	| 22	—1.3	—1.1	40 34 9.23	| 2 14.57	-|- 1	— 36	-|- 4	23.49	|-9	
	4		19.9467	23.5903	| 39	— .9	—1.9	40 34 51.61	|- 1 32.12	| 3	— 40	| 3	23.39	-| 9	59. 6
	5		19.2847	24.1827	-|- 51	-| .6	-|- .3	40 34 19.56	-|- 2 3.81	|- 2	| 14	-|- 3	23.59	| 9	
	6		21.4503	22.2717	| 10	— .3	—1.1	40 36 2.51	| 20.77	|- 8	— 19	-|- 1	23.18	| 8	
	7		30.2387[iv]	11.3223[ii]	— 4	-|- .7	— .4	40 28 24.71	| 7 57.76	-|-1.15	-|- 7	-|-15	23.84	. 9	
	8		33.3223[iv]	9.4750[ii]	|- 31	—2.7	— .8	40 26 19.29	|-10 2.35	-|-1.10	— 56	-| 17	22.35	-| 9	
	9		26.5483	14.4500	| 36	— .5	— .2	40 31 18.30	-|- 5 5.66	— 5	— 11	-|- 8	23.88	-|-9	58.1
	10		14.4533	25.5583	0	—1.9	—1.7	40 41 3.59	— 4 40.48	-|- 23	— 54	—12	22.68	| 7	
	II 1		20.2490	19.5080	0	|- .3	-| .1	40 36 42.41	— 18.72	-|- 14	|- 6	— 1	23.88	| 7	56.9
	2		18.8923	19.0880	0	—2.1	—3.0	40 36 28.32	— 4.94	|- 10	— 74	0	22.74	-|-7	
	3		13.3703	30.7267	+210	— .8	—2.3	40 29 4.53	| 7 18.91	— 8	— 43	| 14	23.07	| 8	55.6
	V 1	D	13.3740	29.6053	-|-143	— .6	—1.7	40 29 33 13	+ 6 50.35	— 8	— 32	-|-12	23.20	—1	48.8
	2		22.8940	18.5400	-|- 18	-| .9	-| .1	40 38 12.75	— 1 50.03	|- 10	-|- 17	— 3	22.96	—1	
	3		31.4503[iv]	7.6190[ii]	— 11	—3.2	—2.9	40 26 20.40	-|-10 1.93	-|-1.17	— 92	-|-24	22.82	—1	
	4		28.0190	13.7230	|- 73	— .6	—1 5	40 42 21.42	— 6 1.29	-|- 20	— 29	—11	22.93	—2	
	5		7.9283[II]	31.6563[iv]	— 5	— .5	—2.3	40 26 22.99	| 9 59.34	-|-1.12	— 38	-| 20	23.27	—2	
	6		20.0030	20.9320	-| 3	—1.9	—1.9	40 36 46.15	— 23.47	|- 14	— 57	— 1	22.24	—2	
	7		26.9567	12.1743	— 38	|- .9	— .8	40 42 36.47	— 6 13.29	| 21	|- 5	—13	23.31	—2	
	8		22.0423	17.4090	— 9	—3.4	—3.0	40 34 26.62	-|- 1 57.01	-| 4	— 96	-|- 4	22.75	—2	
	9		28.5730	14.7220	-|-136	— .1	0	40 42 12.95	— 5 50.21	-|- 18	— 1	—10	22.81	—2	
	10		18.4567	21.6153	-| 1	—3.5	—3.2	40 37 42.79	— 1 19.79	| 10	—1.01	— 3	22.06	—2	
	VI 1		16.2407	24.8793	-|- 29	—1.4	—3.4	40 32 45.69	-|- 3 38.28	— 1	— 68	-|- 7	23.35	—3	
	2		25.3940	18.3873	-|- 78	—2.4	—3.3	40 33 27.26	|- 2 57.18	— 0	— 83	-| 5	23.66	—3	
	3		29.7073	13.7137	| 160	—1.9	—1.1	40 43 8.11	— 6 44.39	-|- 21	— 46	—13	23.34	—3	46.3
	4		24.3440	17.9637	-|- 41	—1.3	—2.2	40 33 42.10	|- 2 41.28	— 0	— 50	|- 5	22.93	—3	
	5		22.2727	17.9027	| 2	— .8	—2.2	40 38 39.56	— 2 15.65	-|- 12	— 42	— 4	23.57	—3	
	6		8.6413[ii]	29.9437[iv]	— 6	— .9	—1.8	40 27 23.66	|- 8 58,07	-|-1.15	— 38	| 19	22.69	—3	
	7		20.9770	18.5927	— 3	— .3	—1.4	40 37 21.25	— 1 0.22	-|- 8	— 23	— 2	23.86	—4	

1892	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
Oct.								° ′ ″					° ′ ″		
19	VI 8		12.9573	29.2467	+105	0	— .1	40 43 14.51	— 6 51.72	+ 21	— 1	—12	40 36 22.87	—3	46.3
Oct.	9		29.6150iv	9.7393ii	0	—1.7	—3.5	40 28 0.50	+ 8 22.04	+ 1.14	— 74	+ 16	23.10	—3	44.7
21	I 1	R	18.9013	25.0020	+ 70	+ .4	+ .2	40 33 48.77	+ 2 34.27	+ 1	+ 9	+ 4	23.18	+9	56.9
	2		14.6940	28.8910	+151	—2.8	—3.5	40 42 22.80	— 5 58.97	+ 19	— 93	—10	22.99	+9	
	3		19.1830	24.5107	+ 59	+ .4	— .7	40 34 9.23	+ 2 14.72	+ 1	— 2	+ 4	23.98	+ 9	55.4
	4		23.1043	19.4567	+ 27	—2.2	—2.4	40 34 51.63	+ 1 32.20	— 3	— 68	+ 3	23.21	+9	
	5		24.3007	19.3673	+ 53	—2.8	—3.7	40 34 19.61	+ 2 4.74	+ 2	— 95	+ 3	23.45	+9	
	6		24.3480	23.5130	+ 19	— .8	—1.5	40 36 2.58	+ 21.14	+ 8	— 33	+ 1	23.48	+9	53.6
	8		9.0550ii	32.9323iv	+ 22	— .5	—1.3	40 26 19.41	+10 3.15	+ 1.10	— 25	+ 17	23.58	+ 9	52.4
	9		16.7263	28.8047	+196	— .1	—1.6	40 31 18.44	+ 5 5.57	— 5	— 22	+ 8	23.82	+9	
	10		28.6770	17.6000	+206	0	—1.5	40 41 3.75	— 4 40.30	+ 23	— 19	—12	23.37	+ 7	52.4
II	1		21.5627	22.2903	+ 8	—2.9	—3.3	40 36 42.58	— 18.40	+ 14	— 92	— 1	23.39	+ 7	
	2		21.8040	21.6080	0	—1.2	—1 9	40 36 28.52	— 4.95	+ 10	— 45	0	23.22	+7	51.7
	3		30.4873	13.1200	+185	—2.2	—1.5	40 29 4.86	+ 7 19.13	— 8	— 57	+14	23.48	+ 8	50.9
V	1	R	29.8907	13.6753	+170	—1.5	—1.6	40 29 33.33	+ 6 50.04	— 8	— 46	+ 12	22.95	—1	44.1
	2		19.9930	24.3413	+ 55	+ 1.0	0	40 38 12.92	— 1 49.98	+ 10	+ 17	— 3	23.18	—1	
	3		11.0537ii	34.8760iv	+ 67	— 3	—1.8	40 26 20.50	+10 1.92	+ 1.17	— 28	+ 24	23.55	—1	
	4		14.9957	29.2703	+180	—2.5	—1.3	40 42 24.55	— 6 1.04	+ 20	— 59	—11	23.01	—1	
	5		33.1123iv	9.3827ii	+ 27	— .5	— .2	40 26 23.09	+ 9 59.48	+ 1.12	— 11	+20	23.78	—2	43.1
	6		24.0117	23.1193	+ 18	— .3	—1.7	40 36 46.20	— 22.59	+ 14	— 27	— 1	23.47	—2	
	7		15.5940	30.3433	+258	—2.6	—2.1	40 42 36.52	— 6 13.22	+ 21	— 71	—13	22.67	—2	
	8		20.2270	24.8107	+ 68	+ .3	— .2	40 34 26.64	+ 1 55.95	+ 4	+ 2	+ 4	22.69	—2	
	9		13.5760	27.4210	+ 42	— .8	+ .2	40 42 12.96	— 5 49.84	+ 18	— 11	—10	23.09	—2	
	10		23.5457	20.4450	+ 37	—1.0	—3.2	40 37 42.77	— 1 18.42	+ 10	— 58	— 3	23.84	—2	43.0
VI	1		25.2653	16.6300	+ 47	—4.5	—2.8	40 32 45.65	+ 3 38.24	— 1	—1.12	+ 7	22.83	—3	42.4
	2		19.7730	26.7563	+134	+ .3	+ .1	40 33 27.20	+ 2 56 73	— 0	+ 6	+ 5	24.04	—3	
	3		14.6383	30.5923	+245	—4.1	—3.3	40 43 8.03	— 6 43.62	+ 21	—1.12	—13	23.37	—3	
	4		17.2597	23.6670	+ 17	—1.0	—1.3	40 33 41.98	+ 2 41.89	— 0	— 34	+ 5	23.58	—3	41.8
	5		19.1980	24.5553	+ 59	—3.5	—2.6	40 38 39.42	— 2 15.47	+ 12	— 93	— 4	23.10	—3	*a*
	6		34.6177iv	13.2980ii	+ 30	—2.4	—1.6	40 27 23.51	+ 8 58.62	+1.15	— 61	+19	22.86	—3	
	7		19.4417	21.8277	+ 8	—1.6	— .3	40 37 24.07	— 1 0.29	+ 8	— 31	— 2	23.53	—4	
	8		30.8533	14.6220	+262	+ .7	—1.1	40 43 14.30	— 6 50.67	+ 21	— 2	—12	23.70	—4	42.6
Oct.	9		12.2993ii	32.1687iv	0	+ .1	+ .3	40 28 0.26	+ 8 21.91	+1.14	+ 5	+16	23.52	—3	42.5
23	I 1	D	25.0083	18.9210	+ 74	+1.1	+1.7	40 33 48.72	+ 2 33.94	+ 1	+ 41	+ 4	23.12	+ 9	55.0*a*
	2		27.1413	12.8933	0	+ .4	+2.3	40 42 22.79	— 5 59.88	+ 19	+ 36	—10	23.36	+9	
	3		24.0290	18.7517	+ 42	+1.5	+2.7	40 34 9.25	+ 2 13.40	+ 1	+ 60	+ 4	23.30	+ 9	
	4		17.9353	21.5477	— 7	+2.2	+3.0	40 34 51.68	+ 1 31.23	+ 3	+ 76	+ 3	23.73	+ 9	
	5		18.5767	23.4780	+ 31	+ .6	+1.0	40 34 19.69	+ 2 3.87	+ 2	+ 23	+ 3	23.84	+ 9	
	8		33.0250iv	9.1660ii	+ 24	— .6	— .3	40 26 19.54	+10 2.69	+1.10	— 14	+17	23.36	+9	52.9
	9		27.9260	15.8713	+135	— .6	— .3	40 31 18.62	+ 5 4.79	— 5	— 14	+ 8	23.30	+ 9	
	II 1		20.6193	19.8503	0	+ .1	— .4	40 36 42.80	— 19.42	+ 14	— 3	— 1	23.48	+ 7	
	2		20.5323	20.7503	0	—2.2	—2.1	40 36 28.76	— 5.51	+ 10	— 64	0	22.71	+ 7	
	3		13.1227	30.4800	+185	—1.2	—1.8	40 29 5.03	+ 7 18.88	— 8	— 43	+ 14	23.54	+8	51.3
	V 1	D	12.5303	28.7220	+ 57	+ 1.9	+ .9	40 29 33.56	+ 6 49.14	— 8	+ 44	+12	23.18	0	45.6
	2		20.7237	16.3733	— 37	—1.0	—1.3	40 38 13.11	— 1 49.80	+ 10	— 34	— 3	23.04	—1	
	3		31.2983iv	7.4963ii	— 15	— .5	— .8	40 26 20.64	+10 1.19	+1.17	— 19	+ 24	23.05	—1	45.5
	4		26.3777	12.0910	— 65	—1.7	—1.7	40 42 24.69	— 6 0.71	+ 20	— 51	—11	23.56	—1	
	5		8.0880ii	31.8173iv	— 1	+1.8	0	40 26 23.21	+ 9 59.39	+1.12	— 30	+ 20	23.62	—2	
Oct.	6		20.1630	21.0987	+ 4	—2.9	—1.6	40 36 46.26	— 23.65	+ 14	— 70	— 1	22.04	—2	45.4
24	I 2	R	14.5427	28.7530	+137	—2.4	—2.1	40 42 22.77	— 5 59.29	+ 19	— 68	—10	22.89	+9	47.1
	3		19.8007	25.1057	+ 76	— .1	— .6	40 34 9.25	+ 2 14.19	+ 1	— 9	+ 4	23.40	+9	
	4		26.5597	22.9373	+101	+ .3	— .7	40 34 51.70	+ 1 31.76	+ 3	— 4	+ 3	23.48	+ 9	
	5		24.0010	19.0987	+ 44	—1.7	—1.9	40 34 19.72	+ 2 3.94	+ 2	— 53	+ 3	23.18	+9	46.1
Oct.	6		24.9517	24.1530	+ 20	0	+ .1	40 36 2.73	+ 20.23	+ 8	+ 1	+ 1	23.06	+ 8	45.2
30	I 5	D	18.1607	23.0460	+ 18	— .3	— .2	40 34 19.51	+ 2 3.45	+ 3	— 7	+ 3	22.95	+ 9	47.7

1892	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
Oct. 30		6	18.5357	19.3257	— 5	+ .7	+1.6	° ′ ″ 40 36 2.63	+ 19.94	+ 9	+ 32	+ 1	° ′ ″ 40 36 22.99	+8	
		7	32.0200iv	13.1583ii	— 20	— .2	— .4	40 28 24.98	+ 7 56.39	+ 1.22	— 8	+ 15	22.66	+8	
		8	33.8360iv	10.0163ii	+ 43	+ .1	+ .2	40 26 19.66	+10 1.79	+1.18	+ 4	+ 17	22.84	+9	
		9	27.3353	15.2983	+ 92	+ .7	— .2	40 31 18.81	+ 5 4.28	— 1	+ 9	+ 8	23.25	+9	
		10	14.4323	25.5983	0	— .1	+ .5	40 41 4.30	— 4 42.05	+ 19	+ 5	—12	22.37	+7	45.6
	II	1	22.4637	21.6620	+ 10	—1.9	— .8	40 36 43.24	— 20.27	+ 13	— 43	— 1	22.66	+7	45.1
		2	19.2777	19.5237	0	— .2	+ .9	40 36 29.28	— 6.21	+ 10	+ 8	0	23.25	+7	
		3	13.2400	30.5687	+ 195	— .4	— 1.0	40 29 5.69	+ 7 18.21	— 2	+ 20	+14	23.82	+8	
		4	22.6017	18.3653	+ 13	—1.9	—3.5	40 38 9.96	— 1 47.04	+ 12	— 77	— 4	22.23	+7	43.5
		6	33.2243iv	11.9160ii	+ 4	— .6	—1.4	40 27 49.48	+ 8 32.23	+1.19	— 28	+14	22.76	+8	
		7	12.9587ii	28.9220iv	— 22	—2.2	—3.3	40 29 39.64	+ 6 43.17	+ 1.21	— 80	+ 12	23.34	+8	
		8	29.3240	11.2807	+ 158	+ .3	— .4	40 42 43.66	— 6 20.39	+ 15	0	—11	23.31	+8	
		9	18.2493	20.5157	— 8	—1.2	—2.4	40 37 20.78	— 57.23	+ 13	— 51	— 2	23.15	+6	42.3
	V	6 D	19.4443	20.4150	+ 2	—1.0	—1.4	40 36 46.90	— 24.52	+ 14	— 35	— 1	22.16	—1	39.2
		7	27.5480	12.7307	+ 13	—1.5	—2.6	40 42 37.20	— 6 14.33	+ 16	— 59	—13	22.31	—2	
		9	29.9267	16.1323	+ 246	—1.0	—1.2	40 42 13.49	— 5 49 08	+ 14	— 32	—10	24.13	—2	
		10	20.4410	23.5983	+ 38	+ .7	— .3	40 37 43.17	— 1 19 85	+ 9	+ 8	— 3	23.46	—2	39.2
	VI	1	15.4953	24.1277	— 10	— .9	—1.7	40 32 45.93	+ 3 38.04	+ 2	— 37	+ 7	23.69	—3	
		2	24.9207	17.9310	+ 57	—2.5	—3.1	40 33 27.39	+ 2 56.71	+ 2	— 82	+ 5	23.35	—3	
		3	28.4627	12.4567	+ 43	— .4	—1.6	40 43 8.11	— 6 44.44	+ 16	— 27	—13	23.43	—3	
		4	23.2653	17.8913	+ 18	—1.2	—1.7	40 33 41.82	+ 2 41.06	+ 2	— 42	+ 5	22.53	—3	37.6
		5	24.3283	18.9580	+ 52	—1.9	—2.9	40 38 39.17	— 2 15.79	+ 10	— 70	— 4	22.74	—3	*a*
		6	10.2803ii	31.6173iv	+ 7	+ .2	— .4	40 27 23.16	+ 8 59.01	+ 1.22	— 1	+ 19	23.57	—3	37.5
		8	12.4813	28.7137	+ 59	—1.6	—1.0	40 43 13.70	— 6 50.93	+ 16	— 40	—12	22.41	—4	
		9	31.4900iv	11.5943ii	0	—1.0	—1.2	40 27 59.50	+ 8 22.59	+1.21	— 32	+ 16	23.14	—4	36.3
		10	24.0840	18.1707	+ 40	— .4	— .3	40 33 52.94	+ 2 29.48	+ 3	— 11	+ 4	22.38	—4	
		11	14.3693	27.0563	+ 54	—1.5	—3.0	40 31 3.13	+ 5 20.63	— 0	— 64	+ 10	23.22	—4	
		12	30.4850	8.9913	— 31	—1.7	—1.8	40 27 20.56	+ 9 2.88	— 5	— 52	+17	23.04	—4	35.9
Nov. 5	VII	2	25.6013	16.8433	+ 63	+ .4	— .6	40 40 4.32	— 3 41.39	+ 11	0	— 7	22.97	—4	35.9*a*
	I	5 R	24.8843	20.0173	+ 70	+ 1.4	+ 1.6	40 34 19.26	+ 2 3.12	+ 3	+ 44	+ 3	22.88	+9	
		6	23.2530	22.4567	+ 14	+ .1	+ 1.5	40 36 2.50	+ 20.15	+ 9	+ 21	+ 1	22.96	+8	34.2
		7	11.9987ii	30.8263iv	— 9	+ 2.7	+ 3.2	40 28 24.91	+ 7 55.60	+1.22	+ 87	+ 15	22.75	+8	
		8	10.8767ii	34.7077iv	+ 61	+ 2.1	+1.1	40 26 19.64	+10 2.17	+ 1.18	+ 50	+17	23.66	+9	
		9	16.2880	28.3073	+ 163	+ 2.0	+ 2.4	40 31 18.85	+ 5 4.05	— 1	+ 65	+ 8	23.62	+9	32.9
	II	2	22.6030	23.2733	+ 5	+ 5.6	+ 6.0	40 36 29.58	— 8.34	+ 10	+ 1.73	0	23.07	+7	32.6
		3	31.2757	14.0193	+ 272	+ .6	+ 1.5	40 29 6.06	+ 7 16.62	— 2	+ 30	+ 14	23.10	+8	32.6
Nov. 8		5	30.6520iv	12.9323ii	+ 23	+ 3.6	+ 5.8	40 28 52.16	+ 7 27.58	+1.21	+1.36	+13	22.44	+8	32.5
	I	8 D	33.8863iv	10.0347ii	+ 45	— .2	— .6	40 26 19.64	+10 2.59	+1.18	— 11	+ 17	23.47	+9	51.2
		9	28.4560	16.4230	+ 172	+ .7	— .2	40 31 18.90	+ 5 4.37	— 1	+ 9	+ 8	23.43	+9	
		10	13.7070	24.8777	— 47	+ .9	+ .3	40 41 4.61	— 4 42.04	+ 19	+ 19	—12	22.83	+7	50.2
	II	1	21.6350	20.7890	+ 7	+ 1.0	+1.1	40 36 43.66	— 21.39	+ 13	+ 31	— 1	22.70	+7	
		2	19.7827	20.0520	0	+ .3	— .5	40 36 29.78	— 6.80	+ 10	— 1	0	23.07	+7	
		3	12.2793	29.5590	+ 93	+ .9	— .4	40 29 6.31	+ 7 16.70	— 2	+ 10	+ 14	23.23	+8	48.5
		4	23.2843	18.9977	+ 30	—1.2	—1.5	40 38 10.68	— 1 48.35	+ 12	— 40	— 4	22.01	+8	48.4
		5	12.6310	30.4600	+ 163	— .5	— .8	40 28 52.49	+ 7 30.76	— 4	— 19	+ 13	23.15	+8	
		6	31.8583iv	11.6110ii	+ 3	— .2	— .4	40 27 50.43	+ 8 31.44	+ 1.19	— 8	+ 14	23.12	+8	
		7	14.4280ii	30.2787iv	— 56	+ 1.4	+1.9	40 29 40.65	+ 6 40.23	+1.21	+ 48	+ 12	22.69	+8	
		8	28.8917	13.8383	+ 122	—1.6	—1.8	40 42 44.74	— 6 20.54	+ 15	— 50	—11	23.74	+8	
Nov. 11		9	19.8270	22.1523	+ 11	+ .1	— .1	40 37 21.88	— 58.77	+ 13	0	— 2	23.22	+7	47.3
	I	6 R	23.7383	22.8550	+ 17	—2.6	—3.2	40 36 2.23	+ 22.35	+ 9	— 86	+ 1	23.82	+7	38.7
		7	12.9193ii	31.8147iv	— 15	—1.2	— .9	40 28 24.71	+ 7 57.28	+ 1.22	— 32	+ 15	23.04	+8	
		9	16.4783	28.5327	+ 177	+ 1.5	—2.7	40 31 18.78	+ 5 4.96	— 1	— 60	+ 8	23.21	+9	
		10	28.9697	17.9233	+ 223	+ 1.2	—2.4	40 41 4.59	— 4 39.61	+ 19	— 52	—12	24.53	+7	37.2
	II	1	22.7827	23.6053	+ 15	+ .5	— .1	40 36 43.69	— 20.82	+ 13	+ 7	— 1	23.06	+7	36.8
		2	23.2407	23.0043	+ 5	—2.0	—3.2	40 36 29.84	— 5.98	— 10	— 75	0	23.21	+7	

1892	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ − δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
Nov.								° ′ ″					° ′ ″		
11	II 3		30.9540	13.6847	+236	— .7	—2.3	40 29 6.42	+ 7 16.84	— 2	— 41	+ 14	40 36 22.97	+8	35.6
	4		21.0013	25.2693	+ 79	— .2	— .9	40 38 10.82	— 1 48.02	+ 12	— 15	— 4	22.73	+ 8	35.6
	6		11.1087[ii]	31.3877[iv]	0	—2.3	—1.2	40 27 50.67	+ 8 32.27	+ 1.19	— 93	+14	23.34	+ 8	
	7		31.1637[iv]	15.2303[ii]	— 76	—4.8	—4.6	40 29 40.91	+ 6 42.30	+1.21	—1.41	+12	23.13	+ 8	
	8		14.8967	29.9960	+218	+ 1.3	+ 1.6	40 42 45.03	— 6 21.97	+ 15	+ 42	—11	23.52	+ 8	
Nov.	9		25.2543	22.9807	+ 53	—2.9	—3.5	40 37 23.20	— 57.56	+ 13	— 95	— 2	23.80	+7	34.7
13	I 5	D	19.0670	21.0293	+ 41	— .8	—1.7	40 34 18.57	+ 2 5.47	+ 3	— 36	+ 3	23.74	+8	39.7
	6		19.9013	20.7400	+ 2	— .1	—1.3	40 36 1.99	+ 21.19	+ 9	— 18	+ 1	23.10	+ 7	37.9
	7		30.3000[iv]	11.4207[ii]	— 5	+ .3	1.6	40 28 21.51	+ 7 56.89	+ 1.22	— 15	+ 15	25.62	+8	
	8		32.6750[iv]	8.8127[ii]	+ 18	— .8	—1.6	40 26 19.28	+ 10 2.83	+ 1.18	— 31	+ 17	23.12	+ 8	
	9		27.2670	15.2107	+ 88	— .6	— .8	40 31 18.61	+ 5 4.78	— 1	— 20	+ 8	23.26	+ 8	37.7
	10		14.9373	26.0713	+ 33	— .8	+ .3	40 41 4.50	— 4 41 34	+ 19	— 9	—12	23.14	+ 7	
	II 1		20.8150	19.9937	+ 3	+1.3	+ 2.3	40 36 43.62	— 20.75	+ 13	+ 51	— 1	23.50	+ 7	
	2		20.7363	20.9990	+ 0	— .4	—1.6	40 36 29.78	— 6.61	+ 10	— 27	0	22.97	+ 7	37.8
	3		12.5447	29.8130	+119	+ .6	+ .4	40 29 6.39	+ 7 16.51	— 2	+ 15	+ 14	23.17	+8	37.4
	4		23.2783	19.0013	+ 30	+ .6	—1.6	40 38 10.81	— 1 48.12	+ 12	— 10	— 4	22.70	+ 7	
	5		13.7820	31.5917	+282	+ .9	—1.2	40 28 52.69	+ 7 30.60	— 4	0	+ 13	23.38	+8	
	6		31.8453[iv]	11.5957[ii]	0	—1.6	—2.4	40 27 50.71	+ 8 31.53	+1.19	— 58	+ 14	22.99	+8	
	7		13.9580[ii]	29.8283[iv]	— 44	— .8	— .4	40 29 40.98	+ 6 40.79	+1.21	— 18	+ 12	22.92	+ 8	
	8		28.9703	13.8690	+127	— .1	— .2	40 42 45.13	— 6 21.80	+ 16	— 4	—11	23.34	+8	37.0
	9		19.0237	21.3750	+ 5	— .9	—2.0	40 37 22.32	— 59.41	+ 13	— 41	— 2	22.61	+7	37.0
	VI 3	R	12.6310	28.6740	+ 61	+ .3	+ .2	40 43 8.36	— 6 45.43	+ 16	+ 7	—13	23.03	—3	37.0
	4		18.5797	24.9590	+ 67	— .1	—1.4	40 33 41.74	+ 2 41.32	+ 2	— 19	+ 5	22.94	—3	37.1
	5		20.4083	25.7700	+ 97	—2.0	— .5	40 38 38.96	— 2 15.69	+ 10	— 42	— 4	22.91	—3	
	6		33.8000[iv]	12.4667[ii]	+ 26	— .9	— .2	40 27 22.79	+ 8 58.98	+ 1.22	— 18	+19	23.00	—3	
	8		28.8277	12.6300	+ 68	+ 1.6	+ .2	40 43 12.98	— 6 49.35	+ 16	+ 30	—12	23.97	—4	37.0
	9		12.5543[ii]	32.4947[iv]	+ 0	+ .1	—1.1	40 27 58.53	+ 8 23.72	+ 1.21	— 12	+16	23.50	—4	
	10		19.6527	25.6473	+ 93	+ .4	— .6	40 33 51.72	+ 2 31.67	+ 3	0	+ 4	23.46	—4	
	11		29.4350	16.7103	+230	—1.1	—1.1	40 31 1.80	+ 5 22.02	— 0	— 33	+ 10	23.59	—4	
	12		12.0283	33.5973	+359	—1.4	—1.9	40 27 18.95	+ 9 5.77	— 5	— 48	+ 17	24.36	—4	35.4
	VII 1		31.3967	16.6520	+ 350	—1.1	—1.6	40 30 10.54	+ 6 13.36	— 0	— 39	+ 13	23.61	—4	
	2		18.6667	27.3207	+ 153	+ .3	+ .4	40 40 2.41	— 3 38.99	+ 11	0	— 7	23.46	—4	
Nov.	3		22.8863	19.5637	+ 22	—3.2	—2.7	40 35 0.02	+ 1 24.00	+ 4	— 89	+ 3	23.20	—5	35.3
16	VI 4	D	23.4243	17.0313	+ 8	—1.5	—2.3	40 33 41.76	+ 2 41.51	+ 2	— 54	+ 5	22.80	—3	15.3
	5		23.0957	17.7173	+ 13	—3.0	—3.2	40 38 38.96	— 2 15.13	+ 10	— 92	— 4	22.97	—3	
	7		21.3693	18.9850	+ 00	+ .6	— .0	40 37 23.01	— 1 0.23	+ 7	+ 10	— 2	22.96	—4	44.4
	8		12.3710	28.5993	+ 47	+ .6	— .3	40 43 12.89	— 6 50.05	+ 16	+ 6	—12	22.94	—4	
	9		29.6537[iv]	9.7233[ii]	+ 0	— .7	— .6	40 27 58.39	+ 8 23.45	+1.21	— 19	+ 16	23.02	—4	
	10		23.0177	16.9767	0	—1.3	—3.2	40 33 51.54	+ 2 32.59	+ 3	— 63	+ 4	23.57	—4	41.9
	11		15.2477	27.9583	+ 120	— .5	— .9	40 31 1.60	+ 5 21.38	— 0	— 20	+ 10	23.88	—4	42.1
	12		30.2563	8.6877	— 67	—1.3	— .7	40 27 18.70	+ 9 4.66	— 5	— 31	+ 17	23.17	—4	42.1
	VII 1		11.7013	26.4950	— 79	—1.2	—1.8	40 30 10.28	+ 6 13.42	— 0	— 43	+13	23.40	—4	
	2		24.5320	15.8497	+ 10	+ 3	0	40 40 2.11	— 3 39.35	+ 11	+ 5	— 7	22.85	—5	
	3		17.0093	20.3380	— 26	— .7	—1.4	40 34 59.69	+ 1 24.02	+ 4	— 30	+ 3	23.48	—5	41.0
	5		11.9537	29.6147	+ 82	—1.2	—3.1	40 28 57.93	+ 7 26.33	— 5	— 60	+ 13	23.74	—5	41.1
Nov.	7		15.0390	26.7403	+ 61	— .2	—1.3	40 41 19.21	— 4 55.74	+ 12	— 20	— 8	23.34	—5	40.4
17	I 8	R	8.8637[ii]	32.7173[iv]	+ 19	+ .9	— .4	40 26 18.95	+ 10 3.30	+ 1.18	+ 10	+17	23.70	+8	55.3
	9		11.8830	23.9633	—148	+ .1	— .8	40 31 18.32	+ 5 4.75	— 1	— 9	+ 8	23.05	+ 8	
	10		25.4193	14.2980	— 11	+ .1	—1.6	40 41 4.35	— 4 40.87	+ 19	— 20	—12	23.35	+ 7	55.3
	II 1		21.5277	22.3657	+ 12	+ .2	+1.2	40 36 43.51	— 21.20	+ 13	+ 19	— 1	22.62	+ 7	55.3
	2		21.5427	21.2890	0	—1.5	—1.4	40 36 29.70	— 6.41	+ 10	— 43	0	22.96	+ 7	
	3		28.0480	10.7507	— 63	— .7	—2.9	40 29 6.34	+ 7 16.74	— 2	— 49	+ 14	22.71	+ 8	53.5
	4		19.5963	23.8617	+ 42	—1.8	— .2	40 38 10 83	— 1 47.84	+ 12	— 33	— 4	22.74	+ 7	
	5		29.1567	11.3393	+ 26	—2.1	— .8	40 28 52.71	+ 7 30.10	— 4	— 46	+13	22.44	+ 8	53.5
	6		8.1077[ii]	28.3297[iv]	— 00	+ .6	— .2	40 27 50.80	+ 8 30.77	+ 1.19	+ 7	+14	22.97	+8	

1892	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Nov. 20	II 7		28.9503iv	13.0967II	— 35	— .9	—1.5	40 29 41.09	+ 6 40.36	+1.21	— 35	+12	40 36 22.43	+8	
	8		12.4353	27.5600	— 1	—2.9	—1.5	40 42 45.28	— 6 22.01	+ 15	— 69	—11	22.62	+8	
	9		23.2027	20.8307	+ 28	+ .8	0	40 37 22.51	— 59.99	+ 13	+ 13	— 2	22.76	+7	54.4
	VI 7	R	18.9610	21.2617	+ 4	—2.2	—4.9	40 37 22.87	— 58.14	+ 7	—1.00	— 2	23.78	—4	32.0
	8		28.9653	12.8040	+ 84	—1.4	— .4	40 43 12.66	— 6 48.48	+ 16	— 29	—12	23.93	—4	
	9		10.6513II	30.6013iv	— 0	—1.3	—1.2	40 27 58.09	+ 8 23.98	+1.16	— 37	+16	23.02	—4	
Nov. 22	10		16.8540	22.8770	— 5	+1.7	+1.8	40 33 51.18	+ 2 32.14	+ 3	+ 52	+ 4	23.91	—4	32.5
	VI 9	R	10.0157II	29.9720iv	0	— .3	— .5	40 27 58.01	+ 8 24.16	+1.12	— 11	+16	23.34	—4	
	10		16.7713	22.7907	— 8	+ .9	+ .4	40 33 50.96	+ 2 32.05	+ 3	+ 20	+ 4	23.28	—4	28.2
	11		26.1470	13.3913	— 17	— .8	— .9	40 31 1.06	+ 5 22.20	— 0	— 25	+10	23.11	—4	27.7
	12		10.9727	32.5430	+225	+1.0	— .3	40 27 18.05	+ 9 5.50	— 5	+ 13	+17	23.80	—4	
	VII 2		15.2960	23.9317	— 21	—2.9	—1.5	40 40 1.33	— 3 38.11	+ 11	— 69	— 7	22.57	—5	
	3		21.8243	18.4680	+ 3	—1.7	— .9	40 34 58.84	+ 1 24.80	+ 4	— 40	+ 3	23.31	—5	
	5		29.3600	11.7087	+ 54	— .9	— .4	40 28 56.92	+ 7 26.04	— 5	— 20	+13	22.84	—5	
	6		27.7630	13.6850	+ 61	+ .7	+ .3	40 42 19.22	— 5 55.81	+ 14	+ 16	—10	23.61	—5	26.8
	7		25.9657	14.2837	+ 9	+ .8	0	40 41 17.99	— 4 55.15	+ 12	+ 13	— 8	23.01	—5	
	8		19.3770	21.6607	+ 9	— .2	+ .7	40 37 19.76	— 57.72	+ 6	+ 5	— 2	22.13	—5	
Nov. 26	10		20.7647	21.6373	+ 8	+1.8	+1.9	40 36 43.95	— 22.06	+ 6	+ 55	— 1	22.49	—5	27.2
	VI 10	D	22.5507	16.5010	— 17	—1.3	—2.4	40 33 51.00	+ 2 32.79	+ 3	— 53	+ 4	23.33	—4	24.6
	11		13.6047	26.3847	0	—1.6	—1.0	40 31 0.96	+ 5 22.87	— 0	— 40	+10	23.53	—4	
	VII 1		11.1823	25.9957	—124	+ .3	— .8	40 30 9.38	+ 6 13.93	— 0	— 5	+13	23.39	—4	24.5
	2		25.4947	16.8967	+ 61	—1.5	—1.8	40 40 1.07	— 3 37.38	+ 11	— 48	— 7	23.25	—5	
	3		17 5880	20.9727	— 15	— .8	—1.4	40 34 58.53	+ 1 25.47	+ 4	— 31	+ 3	23.76	—5	
	5		12.5347	30.2310	+142	— .8	—2.2	40 28 56.50	+ 7 27.43	— 5	— 42	+13	23.59	—5	
	6		13.1140	27.1880	+ 13	+ .1	—1.2	40 42 18.72	— 5 55.60	+ 12	— 14	—10	23.00	—5	22.3
	7		13.8847	25.5340	— 19	— .5	—1.7	40 41 17.40	— 4 54.26	+ 12	— 30	— 8	22.88	—5	
	8		20.8523	18.6750	— 2	—1.6	—2.9	40 37 19.10	— 55.00	+ 6	— 65	— 2	23.49	—5	22.3
	9		12.4800	25.1400	— 90	—1.4	—1.5	40 31 4.17	+ 5 19.61	+ 2	— 43	+11	23.48	—5	
	10		20.1767	19.3977	0	— .6	—1.2	40 36 43.18	— 19.68	+ 6	— 25	— 1	23.30	—5	22.3
	VIII 1		18.2933	21.3187	— 4	— .2	— .7	40 37 39.20	— 1 16.42	+ 7	— 12	— 2	22.71	—5	22.3
Dec. 1	2		25.8810	13.5353	— 21	—1.2	—1.3	40 31 10.68	+ 5 11.85	+ 3	— 37	+12	22.31	—5	22.2
	II 3	D	11.7883	29.1067	+ 45	—1.7	—3.4	40 29 5.90	+ 7 17.62	+ 3	— 73	+14	22.96	+7	30.5
	4		22.0540	17.7850	— 2	—1.0	—1.5	40 38 10.67	— 1 47.84	+ 11	— 36	— 4	22.54	+7	
	5		12.1303	29.9367	+107	— .5	—1.1	40 28 52.56	+ 7 30.10	+ 2	— 22	+13	22.59	+8	30.4
	6		31.0253iv	10.8203II	0	— .7	+ .1	40 27 50.86	+ 8 30.43	+1.05	— 10	+14	22.38	+8	
	7		12.1153II	27.9560iv	— 1	+ .5	+ .7	40 29 41.28	+ 6 40.17	+1.06	+ 17	+12	22.80	+8	
	8		28.2353	13.0833	+ 59	+1.7	+ .9	40 42 45.66	— 6 22.92	+ 11	+ 40	—11	23.14	+8	
	9		20.4403	22.8487	+ 23	+ .8	+ .7	40 37 23.12	— 1 0.90	+ 13	+ 22	— 2	22.55	+7	30.1
	III 1		16.7253	24.9920	+ 42	— .2	— .2	40 39 51.68	— 3 28.94	+ 8	— 6	— 6	22.70	+8	29.9
	2		5.8713II	34.5057iv	+ 10	+ .3	+ .4	40 24 18.18	+12 3.40	+1.05	+ 10	+21	22.94	+7	
	3		25.0677	14.0140	— 30	+ .8	+ .1	40 41 1.72	— 4 39.17	+ 10	+ 15	— 8	22.72	+7	29.9
	5		17.5073	21.4103	— 14	—2.9	—2.2	40 38 2.23	— 1 38.56	+ 8	— 78	— 3	22.94	+7	
	6		26.1617	12.1393	— 71	+2.0	+2.1	40 42 17.18	— 5 54.06	+ 17	+ 61	—14	23.76	+6	
Dec. 2	7		17.6567	23.5633	+ 21	— .4	+1.8	40 38 52.45	— 2 29.27	+ 7	+ 16	— 4	23.37	+7	30.1
	II 3	R	30.5257	13.2403	+193	+1.1	— .5	40 29 5.87	+ 7 17.14	+ 3	+ 12	+14	23.30	+7	35.4
	4		18.2100	22.4733	+ 9	—2.1	—2.0	40 38 10.64	— 1 47.72	+ 11	— 62	— 4	22.37	+7	35.0
	5		29.3710	11.5490	+ 47	— .8	—1.2	40 28 52.54	+ 7 30.34	+ 2	— 29	+13	22.74	+8	
	6		10.2647II	30.5017iv	0	+ .6	— .2	40 27 50.86	+ 8 31.22	+1.01	+ 7	+14	23.30	+8	
	7		27.8563iv	11.9827II	+ 2	—2.2	—2.5	40 29 41.28	+ 6 41.00	+1.02	— 70	+12	22.72	+8	
	8		12.5187	27.6343	+ 5	—2.0	—1.7	40 42 45.67	— 6 21.86	+ 11	— 56	—11	23.25	+8	
	9		22.3557	20.0000	+ 18	—1.6	—1.8	40 37 23.16	— 59.55	+ 13	— 50	— 2	23.22	+7	33.7
	III 1		24.4273	16.1870	+ 15	— .1	— .2	40 39 51.72	— 3 28.21	+ 8	— 4	— 6	23.49	+8	33.4
	2		34.6310iv	5.9597II	+ 16	— .9	—2.1	40 24 18.23	+12 4.33	+1.01	— 42	+21	23.36	+7	
	4		15.7830	27.4483	+113	—1.4	— .3	40 41 18.42	— 4 54.97	+ 9	— 28	— 8	23.18	+7	33.5
	5		22.7487	18.8283	+ 19	— .8	— .2	40 38 2.32	— 1 39.09	+ 8	— 16	— 3	23.12	+7	33.3

1892	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
Dec. 2	III 6		13.9450	27.9417	+ 79	0	−1.0	40 42 17.26	— 5 53.78	+ 16	— 13	−14	40 36 23.37	+6	33.5
	7		21.7507	15.8313	— 41	— .3	−1.5	40 38 52.55	— 2 29.43	+ 7	— 24	— 4	22.91	+7	33.5
Dec.	8		15.1960	25.7843	+ 31	−2.6	−2.9	40 40 51.67	— 4 27.56	+ 11	— 82	— 9	23.31	+6	33.8
3	II 3	D	11.4737	28.7547	+ 12	+2.3		.2	40 29 5.84	+ 7 16.56	+ 3	+ 41	+14	22.98	+7	41.5
	6		29.3603iv	9.1443ii	0	— .6	— .9	40 27 50.86	+ 8 30.67	−1.01	— 21	+14	22.47	+8	
	7		12.0283ii	27.8530iv	+ 2	+2.4	1.6	40 29 41.29	+ 6 39.74	+1.02	+ 61	+12	22.78	+8	
	8		27.4493	12.2940	— 12	+1.7		.6	40 42 45.70	— 6 22.80	+ 11	+ 36	−11	23 26	+ 8	41.1
	9		18.8677	21.2647	+ 1	— .7	−1.2	40 37 23.20	— 1 0.55	+ 13	— 27	— 2	22.49	+7	41.1
	III 1		17.2477	25.5123	+ 66	−1.0	−2.3	40 39 51.77	— 3 28.94	+ 8	— 46	— 6	22.39	+8	
	2		6.0847ii	34.7057iv	+ 21	+ .6		.8	40 24 18.28	+12 3.04	+1.01	+ 20	+21	22.74	+7	40.0
	3		24.5407	13.4890	— 63	— .4	— .4	40 41 1.85	— 4 39.01	+ 10	— 12	— 8	22.74	−7	
	4		26.7793	15.1037	+ 68	−1.4	−2.0	40 41 18.50	— 4 55.10	+ 9	— 50	— 8	22.91	+7	39.4
	5		17.7960	21.7303	— 8	— .4	— .7	40 38 2.40	— 1 39.36	+ 8	— 16	— 3	22.93	+7	
	6		25.9750	11.9223	— 88	+2.5	+3.1	40 42 17.36	— 5 54.75	+ 17	+ 82	−14	23.46	+6	38.8
	7		17.7643	23.6893	+ 25	— .8	— .3	40 38 52.66	— 2 29.74	+ 7	— 17	— 4	22.78	+7	38.3
	8		24.9413	14.2900	— 25	+2.1	1.6	40 40 51.79	— 4 29.00	+ 11	+ 56	— 9	23.37	+6	
Dec.	9		13.9437	25.5230	— 17	+1.1	1.3	40 31 30.45	+ 4 52.46	+ 7	+ 36	+11	23.45	+6	
5	II 10		8.6423ii	30.1400iv	— 6	0	0	40 27 18.53	+ 9 3.03	+1.01	0	+15	22.72	+6	37.8
	3	R	28.8523	11.6080	+ 23	+1.2	+ .3	40 29 5.77	+ 7 15.69	+ 3	+ 24	+14	21.87	+7	31.5
	5		29.5650	11.7630	+ 69	−1.0	— .9	40 28 52.50	+ 7 29.90	+ 2	— 28	+13	22.27	+7	31.2
	6		9.5543ii	29.7740iv	0	+ .3	0	40 27 50.85	+ 8 30.80	+1.01	+ 5	+14	22.85	+8	
	7		27.8103iv	11.9513ii	+ 3	−1.3	−1.8	40 29 41.30	+ 6 40.64	+1.02	— 45	+12	22.63	+8	
	8		12.8107	27.9417	+ 34	— .8	0	40 42 45.75	— 6 22.33	11	13	−11	23.29	8	
	9		21.7767	19.4033	+ 10	— .5	−1.6	40 37 23.30	— 59.99	+ 13	— 29	— 2	23.13	+6	30.6
	III 1		24.6607	16.3993	+ 26	— .3	−1.5	40 39 51.87	— 3 28.77	+ 8	— 24	— 6	22.88	+8	
	2		32.4173iv	3.7707ii	— 96	−2.9	−1.6	40 24 18.40	+12 3.45	+1.01	— 70	+21	22.37	+7	
	3		15.5893	26.5980	+ 71	−3.4	−2.8	40 41 1.99	— 4 38.29	+ 10	— 94	— 8	22.78	+7	29.9
	4		14.2750	25.9713	+ 9	— .8	— .4	40 41 18.67	— 4 55.50	+ 9	— 18	— 8	23.00	+7	
	5		22.6020	18.6673	+ 16	+ .2	— .6	40 38 2.60	— 1 39.44	8	— 4	— 3	23.17	7	
	6		13.7920	27.7703	+ 67	−4.1	−3.9	40 42 17.57	— 5 53.30	+ 16	−1.20	−14	23.09	+6	
	7		22.5347	16.6580	— 15	−1.6	−4.0	40 38 52.89	— 2 28.43	+ 7	— 79	— 4	23.70	+7	28.95
	8		15.9253	26.5363	+ 75	−2.8	−3.8	40 40 52.04	— 4 28.25	+ 11	— 96	— 9	22.85	+6	
	9		27.2727	15.6840	+103	−3.8	−4.0	40 31 30.71	+ 4 53.02	+ 7	−1.16	+11	22.75	+6	
	10		31.3463iv	9.8207ii	+ 5	+ .1	— .7	40 27 18.80	+ 9 3.80	+1.01	— 7	+15	23.69	+6	29.4
	VI 12	R	10.0173	31.6677	+108	−3.2	−2.4	40 27 17.22	+ 9 7.22	+ 2	— 85	+17	23.78	−4	
	VII 1		27.8333	13.0030	+ 36	+1.3	−1.3	40 30 8.70	+ 6 14.75	+ 4	+ 5	+13	23.67	−4	
	2		15.7893	24.3733	+ 6	−2.3	−1.2	40 40 0.29	— 3 36.87	+ 8	— 54	— 7	22.89	−5	
	3		21.5310	18.1180	— 4	−1.6	−2.9	40 34 57.65	+ 1 26.21	+ 5	— 53	+ 3	23.41	−5	25.9
	4		24.8580	16.1477	+ 26	+ .3	.6	40 40 3.12	— 3 40.12	+ 13	+ 12	— 9	23.16	−5	
	5		28.6377	10.9187	— 25	−1.5	.4	40 28 55.39	+ 7 27.58	+ 1	— 20	+13	22.91	−5	
	6		28.0653	14.0530	+ 88	— .6	— .9	40 42 17.47	— 5 54.22	+ 10	— 21	−10	23.04	−6	25.8
	7		25.9453	14.3863	+ 11	−2.4	−2.5	40 41 15.98	— 4 52.04	+ 9	— 73	— 8	23.22	−6	
	8		19.2800	21.4083	+ 3	— .8	−1.6	40 37 17.57	— 53.78	+ 6	— 34	— 2	23.49	−6	25.4
	9		27.6157	14.9137	+ 95	+ .6	1.4	40 31 2.59	+ 5 21.14	+ 6	+ 28	+11	24.18	−5	
	10		20.2823	20.9737	0	— .8	— .8	40 36 41.44	— 17.46	+ 6	— 24	— 1	23.79	−6	
	VIII 1		21.4160	18.5030	— 1	— .6	−1.3	40 37 37.32	— 1 13.59	+ 7	— 27	— 2	23.51	−6	24.7
Dec.	2		15.4433	27.8943	+123	— .1	— .8	40 31 8.78	+ 5 14.87	+ 7	— 12	+12	23.72	−5	
9	VII 1	D	10.5773	25.4183	−176	+ .3	1.4	40 30 8.60	+ 6 14.47	+ 4	+ 10	+13	23.34	−4	29.1
	2		23.2840	14.7170	— 50	— .1	— .2	40 40 0.15	— 3 36.30	+ 8	— 4	— 7	23.82	−5	
	3		16.0450	19.4757	— 44	— .3	.8	40 34 57.46	+ 1 26.56	+ 5	— 15	+ 3	23.95	−5	29.3
	5		14.5120	32.2280	+352	— .3	— .8	40 28 55.09	+ 7 28.44	+ 1	— 15	+13	23.52	−5	
	6		14.1753	28.1557	+ 93	−1.0	2.4	40 42 17.09	— 5 53.42	+ 9	— 48	−10	23.18	−6	
	7		13.6737	25.2077	— 39	−2.6	−3.0	40 41 15.52	— 4 51.28	+ 9	— 83	— 8	23.42	−6	28.6
	8		22.9347	20.8337	+ 22	−1.2	−1.7	40 37 17.05	— 53.14	+ 6	— 42	— 2	23.53	−6	27.8
	10		20.6143	19.9340	0	+ .4	+ .8	40 36 40.79	— 17.18	+ 6	+ 17	— 1	23.83	−6	28.2

1892	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
Dec. 10	II 4	D	21.0663	16.7940	— 27	+ .8	+ .5	40 38 10.21	— 1 47.86	+ 11	+20	− 4	40 36 22.65	+6	
	5		11.8393	29.6693	+ 79	− .3	− .8	40 28 52.11	+ 7 30.63	+ 2	− 15	+ 13	22.71	+7	31.2
	6		29.8993iv	9.6520ii	0	−2.1	−1.6	40 27 50.55	+ 8 31.50	+1.01	— 56	+ 14	22.61	+7	
	7		12.2753i	28.0700iv	— 5	+4.6	+5.3	40 29 41.05	+ 6 39.00	+1.02	+1.47	+12	22.66	+7	30.4
	8		27.5123	12.3783	— 4	— .1	−1.1	40 42 45.58	— 6 22.31	+ 11	— 15	−11	23.12	+7	
	III 1		16.5127	24.7857	+30	−1.5	−1.2	40 39 51.86	— 3 28.31	+ 8	— 41	− 6	23.16	+7	30.2
	2		8.4803ii	37.0827iv	+141	+1.6	+ .9	40 24 18.46	+12 2.92	+1.01	+ 39	+21	22.99	+7	
	3		25.6640	14.5843	+ 8	+2.0	+2.0	40 41 2.11	— 4 39.92	+ 10	+ 60	− 8	22.81	+7	
	4		25.8787	14.1643	+ 2	— .1	− .6	40 41 18.86	— 4 55.94	+ 9	— 9	− 8	22.84	+7	30.0
	5		17.0000	20.9463	— 24	−1.4	−1.4	40 38 2.89	— 1 39.63	+ 8	— 42	− 3	22.89	+7	
	6		26.5843	12.5360	— 38	+ .6	+ .7	40 42 17.93	— 5 54.80	+ 17	+ 19	−14	23.35	+6	29.7
	7		17.9987	23.9307	+ 33	−1.8	−1.2	40 38 53.30	— 2 29.94	+ 7	— 46	− 4	22.93	+7	29.6
	8		24.1550	13.4850	— 74	+ .8	+ .7	40 40 52.53	— 4 29.36	+ 11	+22	− 9	23.41	+6	
	9		15.0920	26.6523	+59	0	−1.4	40 31 31.22	+ 4 52.19	+ 8	— 18	+ 11	23.42	+6	
	10		11.4597ii	32.9410iv	+ 18	+ .6	− .8	40 27 19.33	+ 9 2.79	+1.01	— 0	+15	23.28	+6	29.9
Dec. 11	VII 4	R	25.8620	17.2083	+ 77	−3.3	−3.0	40 40 2.81	— 3 38.81	+ 13	— 95	− 9	23.09	−5	26.3
	5		29.1893	11.4367	+33	−1.7	−1.9	40 28 55.01	+ 7 28.57	+ 1	— 53	+13	23.19	−6	
	6		26.9850	12.9887	0	— .8	− .9	40 42 16.98	— 5 53.59	+ 10	— 25	−10	23.14	−6	27.4
	7		26.4723	14.9190	+ 48	— .5	−1.8	40 41 15.36	— 4 51.99	+ 9	— 31	− 8	23.07	−6	
	8		19.2790	21.4050	+ 6	−3.5	−2.0	40 37 16.87	— 53.73	+ 6	— 85	− 2	22.33	−6	27.0
	9		27.8337	15.0980	+111	−1.0	−1.7	40 31 1.82	+ 5 22.02	+ 6	— 39	+11	23.62	−6	
	10		20.6600	21.3293	+ 3	−1.3	−1.1	40 36 40.55	— 16.91	+ 6	— 36	− 1	23.33	−6	
	VIII 1		21.5297	18.6433	+ 1	— .5	−1.8	40 37 36.34	— 1 12.92	+7	— 31	− 2	23.16	−6	
	2		15.3047	27.7870	+115	0	− .6	40 31 7.74	+ 5 15.63	+ 7	— 7	+12	23.49	−6	
	3		14.9387	26.9270	+65	−3.0	−2.0	40 41 26.87	— 5 3.03	+ 9	— 77	− 9	23.07	−6	
	4		14.7850	23.4397	— 44	— .5	−1.6	40 32 45.26	+ 3 38.53	+ 3	— 29	+ 6	23.59	−6	26.7
	5		30.9377iv	10.9443ii	0	−3.0	−1.9	40 27 57.94	+ 8 25.10	+1.01	— 75	+16	23.49	−6	
Dec. 12	6		20.4923	23.3117	+31	+.4	+ .3	40 37 31.33	— 1 11.31	+ 8	+ 12	− 2	23.20	−6	25.0
	II 5	R	28.9580	11.1233	— 4	— .5	−1.0	40 28 51.87	+ 7 30.55	+ 1	— 21	+13	22.35	+7	33.0
	6		9.1423ii	29.3803iv	0	+ .9	0	40 27 50.33	+ 8 31.26	+97	+ 15	+14	22.85	+7	
	7		28.2790iv	12.4310ii	— 9	+1.0	0	40 29 40.85	+ 6 40.33	+ 98	+ 17	+12	22.45	+7	
	8		14.0407	29.1510	+142	— .7	+ .3	40 42 45.42	— 6 22.08	+ 11	— 7	−11	23.27	+7	33.2
	9		21.5193	19.1470	+ 4	+ .1	− .9	40 37 23.16	— 59.94	+ 13	— 10	− 2	23.23	+6	
	III 1		23.9220	15.6830	— 10	0	− .2	40 39 51.75	— 3 28.11	+ 8	— 2	− 6	23 61	+7	32.6
	2		32.0733iv	3.4307ii	−115	+ .3	− .4	40 24 18.37	+12 3.28	+ 97	0	+21	22.83	+7	
	3		15.1537	26.1910	+ 45	+ .4	+ .2	40 41 2.04	— 4 38.94	+ 10	+ 9	− 8	23.21	+7	
	4		14.1767	25.8763	+ 2	— .2	− .6	40 41 18.82	— 4 55.56	+ 9	— 11	− 8	23.16	+7	32.6
	6		15.2990	29.2927	+189	— .6	− .3	40 42 17.96	— 5 53.98	+ 16	— 14	−14	23.86	+6	32.5
	7		21.3000	15.3603	— 58	+ .4	− .7	40 38 53.36	— 2 29.90	+ 7	— 2	− 4	23.47	+7	
	8		15.4403	26.0660	+ 47	−2.9	−2.3	40 40 52.61	— 4 28.55	+ 11	— 72	− 9	23.36	+6	
	9		27.6443	16.1210	−129	+ .2	+1.1	40 31 31.31	+ 4 51.43	+ 7	+ 17	+11	23.09	+6	
Dec. 15	10		31.5383iv	10.0710ii	+ 6	— .2	− .2	40 27 19.45	+ 9 2.32	+ 97	— 6	+15	22.83	+6	31.5
	VII 4	D	15.4810	24.2010	— 7	+1.7	+1.2	40 40 2.59	— 3 40.27	+ 13	+ 44	− 9	22.80	−5	33.4
	5		12.5773	30.3193	+151	+ .6	− .1	40 28 54.75	+ 7 28.58	+ 1	+ 8	+13	23.55	−6	
	7		13.8523	25.4083	— 26	+ .3	+ .5	40 41 14.96	— 4 51.87	+ 9	+ 11	− 8	23.21	−6	
Dec. 17	VII 4	D	14.2723	22.9543	— 71	— .4	− .8	40 40 2.44	— 3 39.15	+ 13	— 17	− 9	23.16	−5	30.2
	5		11.6707	29.4313	+ 57	−1.2	−1.1	40 28 54.58	+ 7 28.89	+ 1	— 34	+13	23.20	−6	
	6		12.6280	26.6247	— 32	— .1	− .2	40 42 16.48	— 5 53.51	+ 10	— 4	−10	22.93	−6	29.5
	7		14.3947	25.9227	+ 10	−1 0	− .6	40 41 14.76	— 4 51 25	+ 9	— 24	− 8	23.28	−6	
	8		21.2660	19.1790	+ 4	−1.5	− .7	40 37 16.20	— 52.74	+ 6	— 34	− 2	23.16	−6	29.6
	9		14.2013	26.9537	+ 45	— .1	− .8	40 31 1.09	+ 5 22.28	+ 6	— 12	+11	23.42	−6	
	10		21.4510	20.7657	+ 3	− .2	+ .1	40 36 39.74	— 17.32	+ 6	— 2	− 1	22.45	−6	29.0
	VIII 1		18.0190	20.8850	— 9	−1.7	−1.9	40 37 35.45	— 1 12.38	+ 7	— 53	− 2	22.59	−6	28.8
	2		27.1297	14.6197	+ 63	−1.1	0	40 31 6.80	+ 5 16.20	+ 7	— 19	−12	23.00	−6	29.4
	3		26.4030	14.3970	+ 28	+2.0	+ .8	40 41 25.80	— 5 3.37	+ 9	+ 44	− 9	22.87	−7	

1892	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
Dec.								° ′ ″	° ′ ″				° ′ ″		
17	VIII 4		21.9103	16.2577	+ 29	—1.1	— .6	40 32 14.06	+ 3 38.66	+ 3	— 26	+ 6	40 36 22.55	—7	
	5		9.1500[ii]	29.1537[iv]	0	.3	—1.1	40 27 56 80	+ 8 25.35	+ 93	— 19	+ 16	23.05	—6	29.3
	6		21.1763	18.6883	+ 2	+ 2.1	+ 1.0	40 37 33.11	— 1 10 41	- 8	+ 49	- 2	23.22	—6	
	7		28.3923[iv]	12.1887[ii]	— 7	— .8	— .4	40 29 32.21	+ 6 49.33	+ 92	— 18	+ 12	22.40	—6	30.0
	8		19.4690	20.4153	+ 1	— .1	— .1	40 35 58.58	+ 21.66	+ 10	— 3	+ 1	23.32	-6	29.5
Dec.	9		12.6523	26.6167	— 29	— .5	— .3	40 30 29.64	+ 5 53.46	+ 5	— 12	+ 11	23.14	—6	29.4
18	VII 8	R	19.2960	21.3933	+ 6	—1.1	—1.4	40 37 16.08	- 53.00	+ 6	— 37	— 2	22.75	—6	32.0
	9		27.3747	14.6163	+ 76	—1.6	—1.2	40 31 0.95	+ 5 22.50	+ 6	— 43	+ 11	23.19	—6	31.7
	10		21.4873	22.1270	+ 8	—1.8	—2.6	40 36 39.59	— 16.18	+ 6	— 64	— 1	22.82	—6	
	VIII 1		22.8010	19.9737	+ 26	+ .1	— .6	40 37 35.27	— 1 11.49	+ 7	— 6	— 2	23.77	—6	
	2		14.5030	27.0053	+ 55	+ .1	— .2	40 31 6.62	+ 5 15.97	+ 7	— 1	+ 12	22.77	— 6	31.8*a*
	3		14.8567	26.8200	+ 60	— .2	+ .6	40 41 25.60	— 5 2 37	+ 9	+ 4	— 9	23.27	—7	*a*
	4		16.1890	24.8667	+ 28	0	— .2	40 32 43.81	+ 3 39.29	+ 3	— 2	+ 6	23.20	—7	
	5		30.6306[iv]	10.6203[ii]	0	— .8	+ .1	40 27 56.58	+ 8 25.21	+ 89	— 12	+ 16	22.75	—6	32.4
	6		17.5950	20.3653	— 17	— .6	+ .1	40 37 32.88	— 1 9.94	+ 8	— 8	— 2	22.92	—6	
	7		12.0950[i]	28.3330[iv]	— 4	— .3	—2.1	40 29 31.96	+ 6 50.20	+ 88	— 32	+ 12	22.84	—7	32.0
Dec.	8		22.5363	21.5700	+ 11	—1.5	— .1	40 35 58.39	+ 24.44	+ 11	— 27	+ 1	22.68	—6	32.0
20	II 8	D	28.0107	13.9657	+ 44	+ .4	— .4	40 42 44.91	— 6 20.96	+ 11	+ 2	—11	21.00	+ 6	26.5
	9		21.4307	23.7820	+ 37	—1.2	—2.1	40 37 22.92	— 59.50	+ 13	— 47	— 2	23.06	+6	
	III 1		17.2663	25.5073	+ 67	—1.2	—1.9	40 39 51.46	— 3 28.36	+ 8	— 45	— 6	22.67	+ 7	
	2		8.5023[ii]	37.1207[iv]	+ 142	—1.0	—1.8	40 24 18.17	+ 12 3.36	+ 86	— 40	+ 21	22.20	+ 7	25.9
	3		26.1667	15.1103	+ 42	+ .2	— .2	40 41 1.91	— 4 39.43	+ 10	+ 1	— 8	22.54	+ 7	
	4		26.6357	14.9120	+ 52	— .6	—1.0	40 41 18.81	— 4 55.55	+ 9	— 23	— 8	23.04	+ 7	25.6
	5		17.7520	21.7430	— 7	+ .7	+ .1	40 38 3.03	— 1 40.80	+ 8	+ 13	— 3	23.41	+6	24.8
	6		26.9613	13.8680	— 7	— .4	—1.2	40 42 18.18	— 5 56.02	+ 17	— 22	—14	21.97	+ 6	
	7		17.6463	23.5840	+ 21	—2.7	—2.0	40 38 53.65	- 2 30.06	+ 8	— 72	— 4	22.90	+ 7	24.1
	8		25.1803	14.5153	+ 11	—1.4	—2.5	40 40 53.02	— 4 29.41	+ 11	— 56	— 9	23.07	+ 6	
	9		14.7703	26.3080	+ 38	— .6	—1.3	40 31 31.77	+ 4 51.57	+ 7	— 27	+ 11	23.25	+ 6	
Dec.	10		8.3123[ii]	29.7987[iv]	— 8	—2.2	—2.6	40 27 19.94	+ 9 2.80	+ 86	— 71	+ 15	23.04	+ 6	23.2
22	VII 9	D	12.6607	25.4550	— 72	— .8	—1.2	40 31 0.52	+ 5 23.06	+ 6	— 29	+ 11	23.46	—6	20.5*b*
Dec.	10		20.1823	19.5553	0	—1.2	—2.6	40 36 39.10	— 15.84	+ 6	— 54	— 1	22.77	—6	
23	III 1	R	24.3543	16.1130	+ 12	+ .3	— .2	40 39 51.26	— 3 28.23	+ 8	+ 2	— 6	23.07	+ 7	24.0
	2		31.0690[iv]	5.4463[ii]	- 12	+ 1.6	+ 1.4	40 24 18.02	+ 12 3.08	+ 86	+ 45	+ 21	22.62	+ 6	
	3		15.1277	26.1287	+ 40	—3.1	—2.0	40 41 1.83	— 4 38.02	+ 10	— 79	— 8	23.04	+ 6	
	4		14.3137	26.0487	+ 10	+ .5	+ .2	40 41 18.75	— 4 55.74	+ 9	+ 11	— 8	23.13	+ 7	23.7
	5		23.3003	19.3613	+ 31	—2.0	—1.9	40 38 3.01	— 1 39.60	+ 8	— 58	— 3	22.91	+ 6	
	6		13.6520	27.6883	+ 56	— .1	— .6	40 42 18.30	— 5 54.74	+ 17	— 9	—14	23.56	+ 6	
	7		22.8130	16.8650	— 6	— .9	—2.5	40 38 53.74	— 2 30.25	+ 7	— 48	— 4	23.04	+ 7	23.5
Dec.	8		15.2200	25.8917	+ 34	0	— .5	40 40 53.18	- 4 29.77	+ 11	— 6	— 9	23.37	+ 6	
25	VIII 1	D	21.2620	24.0663	+ 42	—1.4	—1.5	40 37 34.47	— 1 10.96	+ 6	— 43	— 2	23.12	—7	14.8
	2		26.5417	13.9587	+ 19	—2.0	—1.9	40 31 5.69	+ 5 17.96	+ 11	— 58	+ 12	23.30	—6	*b*
	4		24.7530	15.9897	+ 21	—3.7	—2.4	40 32 42.61	+ 3 41.46	+ 6	— 94	+ 6	23.25	—7	14.8
	5		10.2310[i]	30.2740[iv]	0	— .1	—1.3	40 27 55.37	+ 8 26.39	+ 96	— 18	+ 16	22.70	—7	
	7		28.0273[iv]	11.7537[ii]	+ 2	— .5	+ 2.1	40 29 30.55	+ 6 51.16	+ 93	+ 18	+ 12	22.94	—7	
	9		11.9110	25.9937	— 88	+ .6	+ .1	40 30 27.89	+ 5 55.58	+ 9	+ 11	+ 11	23.78	—7	14.0
	10		37.6187[iv]	10.2210[ii]	+ 171	— .5	—1.5	40 47 57.32	—11 32.64	— 80	— 28	—23	23.37	—6	
Dec.	11		13.7323	28.8560	+ 115	+ .3	+ 1.7	40 42 45.12	— 6 22.39	+ 5	+ 27	—12	22.92	—7	14.4
26	III 2	D	2.9480[ii]	31.6717[iv]	—138	—2.3	—1.8	40 24 17.74	+ 12 5.35	+ 95	— 62	+ 21	23.63	+ 6	17.3
	3		21.6590	13.5933	— 56	+ 2.3	+ 2.0	40 41 1.59	— 4 39.43	+ 6	+ 65	— 8	22.79	+ 6	
	4		25.0327	13.3457	— 57	—1.4	— .2	40 41 18.54	— 4 55.13	+ 5	— 26	— 8	23.12	+ 7	16.6
	5		18.6900	22.6147	+ 16	—1.1	— .8	40 38 2.91	— 1 39.95	+ 7	— 29	— 3	22.71	+ 6	16.5
	6		26.2063	12.1443	— 71	+ 1.1	+ .2	40 42 18.23	— 5 55.09	+ 12	+ 21	—14	23.33	+ 5	
	7		18.0340	24.0307	+ 35	+ .8	+ 2.4	40 38 53.68	— 2 31.59	+ 5	+ 44	— 4	22.54	+ 6	16.2
	8		25.2023	11.5423	— 9	— .4	— .6	40 40 53.18	— 4 29.31	+ 7	— 14	— 9	23.71	+ 6	16.0
	9		13.3763	24.8787	— 59	+ 1.4	+ .9	40 31 31.97	+ 4 50.46	+ 11	+ 35	+ 11	23.00	+ 5	

1892	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Dec. 26	III 10	D	9.0527[ii]	30.5107[iv]	+ 1	—1.2	— .2	40 27 20.15	+ 9 2.14	+ 93	— 22	+ 15	10 36 23.14	+ 6	16.2
	IV 1		20.8203	18.0490	— 9	+ .3	+ .2	40 35 12.74	+ 1 9.99	+ 8	+ 7	+ 2	22.90	+ 5	15.6
	2		15.3827	26.8157	+ 74	— .2	+ .8	40 41 11.91	− 4 49.04	+ 5	+ 7	— 8	22.91	+ 6	14.5
	3		28.3280	8.7093	—172	+ 1.0	+ .3	40 44 37.47	— 8 15.23	+ 7	+ 21	—17	22.35	+ 5	
	4		28.1710	9.5270	—127	+ .4	+ .2	40 44 14.11	— 7 50.90	+ 4	+ 9	—14	23.20	+ 5	
	5		16.9187	20.9623	— 26	+ 1.5	+ .9	40 34 40.38	+ 1 42.09	+ 5	+ 37	+ 3	22.92	+ 5	15.0
	8		14.0260	26.6030	+ 23	+ .7	+ 1.7	40 41 39.85	— 5 17.82	+ 7	+ 31	−11	22.33	+ 4	15.0
	9		25.4020	12.6153	— 77	+ 1.7	+ 1.5	40 30 59.46	+ 5 22.86	+ 8	+ 48	+ 10	22.98	+ 4	
Dec. 27	10		27.9003[iv]	6.5590[ii]	— 21	— .8	+ 2	40 27 22.06	+ 8 59.13	+ 95	− 11	+ 17	22.20	+ 3	14.4
	III 1	R	23.1600	14.9160	— 47	+ 1.9	+ 1.7	40 39 50.83	— 3 28.17	+ 5	+ 51	— 6	23.19	+ 6	23.0
	2		31.1957[iv]	5.5473[ii]	— 7	+ 1.8	+ .8	40 24 17.65	+ 12 3.76	+ 95	+ 41	+ 21	22.98	+ 6	22.5
	3		15.3637	26.4067	+ 58	+ 3.3	+ 2.7	40 41 1.51	— 4 39.14	+ 6	+ 91	— 8	23.26	+ 6	
	4		13.8063	25.5037	— 21	—1.4	— .5	40 41 18.46	— 4 55.46	+ 5	— 30	— 8	22.67	+ 6	*a*
	5		22.4617	18.5387	+ 12	— .6	— .3	40 38 2.86	— 1 39.14	+ 7	— 14	— 3	23.62	+ 6	21.6*a*
	6		15.3773	29.4153	+ 198	+ 1.4	+ .9	40 42 18.20	— 5 55.16	+ 12	+ 35	—14	23.37	+ 5	
	7		22.1197	16.1687	— 32	— .6	—1.5	40 38 53.65	— 2 30.27	+ 5	— 29	— 4	23.10	+ 6	21.2
	8		15.5407	26.2110	+ 55	+ .4	+ .2	40 40 53.16	— 4 29.72	+ 7	+ 9	— 9	23.51	+ 6	21.0
	10		31.9743[iv]	10 5440[ii]	+ 10	— .5	+ 1.0	40 27 20.15	+ 9 1.44	+ 93	+ 4	+ 15	22.71	+ 6	20.6
	IV 1		20.1190	22.9037	+ 27	— .7	— .5	40 35 12.76	+ 1 10.42	+ 8	— 18	+ 2	23.10	+ 5	
	2		26.7907	15.3800	+ 74	+ .5	— .3	40 41 11.92	— 4 48.47	+ 5	+ 4	— 8	23.46	+ 6	20.3
	3		12.2497[ii]	31.7953[iv]	— 5	+ .4	+ 1.6	40 44 37.51	— 8 13.79	— 79	+ 27	—17	23.03	+ 5	
	4		12.5717[ii]	31.1833[iv]	— 17	+ .8	+ 1.3	40 44 14.15	— 7 50.16	— 82	+ 30	—14	23.33	+ 5	19.9
	5		22.7950	18.7237	+ 19	—1.6	— .3	40 34 40.43	+ 1 42.91	+ 5	— 31	+ 3	23.11	+ 5	19.1
	VIII 1	R	22.7617	19.9903	+ 25	—2.3	—2.3	40 37 34.28	— 1 10.08	+ 6	— 68	— 2	23.56	—7	15.5
	2		13.9673	26.5440	+ 19	—1.7	— .5	40 31 5.50	+ 5 17.80	+ 11	— 35	+ 12	23.18	—6	
	3		14.0667	25.9720	− 0	—1.5	+ .5	40 41 24.32	— 5 0.77	+ 5	— 19	— 9	23.32	—7	*a*
	4		16.1380	24.8660	+ 26	+ .4	— .2	40 32 42.34	+ 3 40.58	+ 6	+ 4	+ 6	23.08	—7	
	5		31.4337[iv]	11.3777[ii]	— 0	+ .8	+ .6	40 27 35.10	+ 8 26.72	+ 96	+ 21	+ 16	23.15	—7	
	6		19.9743	22.7113	+ 24	+ .1	+ .5	40 37 31.29	− 1 9.21	+ 7	+ 8	— 2	22.21	—7	
	7		14.1240[ii]	30.4230[iv]	— 49	+ 1.3	— .6	40 29 30.23	+ 6 51.67	+ 93	+ 14	+ 12	23.09	—7	
	8		23.5360	22.5327	+ 19	+ .8	+ 2.5	40 35 56.69	+ 25.40	+ 10	+ 16	+ 1	22.66	6	16.2
	9		28.7710	14.7037	+ 145	—2.5	— .4	40 30 27.56	+ 5 55.77	+ 9	— 47	+ 11	23.06	—7	15.9
	10		5.8317[ii]	33.2423[iv]	— 21	—1.3	+ 3	40 47 56.97	—11 32.48	− 80	— 18	23	23.28	—7	15.4
	11		29.4720	14.4183	+ 172	—2.0	—3.3	40 42 44.73	— 6 20.77	+ 4	— 76	—12	23.12	−7	
	IX 1		28.6237	12.6810	+ 61	— .5	—1.0	40 29 39.92	+ 6 42.94	+ 8	— 21	+ 13	22.86	—7	14.3
Dec. 28	III 1	D	16.1483	24.3770	+ 14	+ .3	+ .5	40 39 50.73	— 3 27.93	+ 5	+ 11	— 6	22.99	+ 6	22.1*b*
	2		2.9910[ii]	31.6793[iv]	—136	—1.0	— .1	40 24 17.56	+ 12 4.38	+ 95	— 18	+ 21	22.92	+ 6	
	3		25.2567	14.2150	— 18	+ 1.7	+ .3	40 41 1.41	— 4 38.91	+ 6	+ 33	— 8	22.81	+ 6	20.9
	5		18.6593	22.6120	+ 16	— .2	— .2	40 38 2.82	— 1 39.90	+ 7	— 6	— 3	22.90	+ 6	
	6		25.4130	11.3667	—133	+ .5	— .1	40 43 18.17	— 5 55.30	+ 12	+ 7	—14	22.92	+ 5	20.2
	7		18.2230	24 1590	+ 41	—2.9	—1.3	40 38 53.62	— 2 30.08	+ 6	— 66	— 4	22.90	+ 6	19.6
	8		25.3013	14.6087	− 4	+ .8	+ .8	40 40 53.16	— 4 30.13	+ 7	+ 24	— 9	23.25	+ 6	
	9		14.2467	25.7783	0	— .8	—1.4	40 31 31.98	− 4 51.34	+ 11	— 31	+ 11	23.23	+ 5	
	10		8.8283[ii]	30.2823[iv]	— 3	— .9	—1.9	40 27 20 15	+ 9 2.01	+ 93	— 40	+ 15	22.84	+ 6	
	IV 1		21.8627	19.0807	+ 7	— .2	— .2	40 35 12.78	+ 1 10.30	+ 8	— 6	+ 2	23.12	+ 5	18.8
	2		15.0583	26.5040	+ 51	—1.2	+ .8	40 41 11.95	— 4 49.29	+ 5	— 10	— 8	22.53	+ 6	18.3
	3		30.3813[iv]	10.8533[ii]	0	— .8	— .1	40 44 37.53	— 8 13.36	— 79	— 15	—17	23.06	+ 5	
	4		29.3737[iv]	10.7757[ii]	— 1	+ .1	— .7	40 41 14.19	— 7 49.87	— 82	— 7	—14	23.29	+ 5	17.9
	5		19.3473	23.4010	+ 32	— .1	— .2	40 34 40.48	+ 1 42.57	+ 5	— 4	+ 3	23.09	+ 5	17.5
	6		16.3940	23.6553	+ 1	— .6	—2.2	40 39 27.00	— 3 3.45	+ 4	— 38	— 5	23.16	+ 5	
	7		6.3193[ii]	31.6793[iv]	— 32	+ 1.2	+ .8	40 25 39.97	+ 10 40.63	+ 98	+ 31	+ 21	22.13	+ 4	
	8		12.9567	25.5387	— 56	+ 1.9	+ 3.8	40 41 39.99	— 5 17.74	+ 7	+ 81	—11	23.02	+ 4	
	9		25.8493	13.0393	— 45	+ .2	+ .2	40 30 59.60	+ 5 23.52	+ 8	+ 6	+ 10	23.36	+ 4	16.7
	VIII 3	D	26.8190	14.9313	+ 61	—2.5	—3.6	40 41 24.19	— 5 0.49	+ 5	— 89	— 9	22.77	—7	13.0
	4		25.4100	16.6520	+ 52	—1.7	—1.1	40 32 42.18	+ 3 41.41	+ 6	— 43	+ 6	23.28	—7	11.9

1892	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Dec. 28	VIII 5	D	10.1300ii	30.2213iv	0	— .7	— .9	40 27 34.96	+ 8 27.62	+ 96	— 23	+16	40 36 23.47	—7	10.9
	6		21.6720	18.9803	6	—1.3	—2.4	40 37 31.13	— 1 8.03	+ 7	— 53	— 2	22.62	—7	
	7		28.3017iv	11.9840ii	— 3	—2.9	—1.9	40 29 30.07	+ 6 52.27	+ 93	— 74	+12	22.65	—7	
	9		11.1250	25.2353	—153	— .7	—2.3	40 30 27.39	+ 5 56.13	+ 9	— 42	+ 11	23.30	—7	11.8
	10		29.3470iv	1.8970ii	—192	— .6	— .8	40 47 56.79	—11 33.06	— 80	— 20	—23	22.50	—7	11.3
1893	11		13.9483	29.0283	+ 132	—1.6	— .5	40 42 44.52	— 6 21.34	+ 4	— 34	—12	22.76	—7	
Jan.	IX 1		11.8000	27.7660	— 20	—1.5	—2.4	40 29 39.71	+ 6 43.35	+ 8	— 56	+13	22.71	—7	10.6
3	VIII 3	R	15.0147	26.8593	+ 62	—1.6	—1.8	40 41 23.33	— 4 59.41	+ 5	— 50	— 9	23.38	—7	15.7
	4		16 3560	25.1347	+ 37	—2.2	—1.8	40 32 41.19	+ 3 41.89	+ 7	— 60	+ 6	22.61	—7	
	5		32.6240iv	12.5067ii	0	— .2	— .6	40 27 53.97	+ 8 28.26	+ 96	— 11	+16	23.24	—7	
	6		19.9923	22.6327	+ 23	—2.0	— .8	40 37 30.06	— 1 6.76	+ 7	— 44	— 2	22.91	—7	
	7		11.6740ii	28.0240iv	+ 3	— .8	—1.1	40 29 28.93	+ 6 53.09	+ 93	— 27	+12	22.80	—7	17.0
	8		21.9140	20.8097	+ 8	—3.7	—2.1	40 35 55.40	+ 27.92	+ 10	— 90	+ 1	22.53	—7	
	9		27.8340	13.7160	+ 63	— .9	— .2	40 30 26.18	+ 5 56.85	+ 9	— 18	+11	23.05	—7	17.0
	10		9.7310ii	37.0770iv	+147	— .1	+ .2	40 47 55.50	—11 31.26	— 80	+ 1	—23	23.22	—7	
	11		29.2703	14.2627	+156	— .2	— 8	40 42 43.12	— 6 19.56	+ 4	— 14	—11	23.35	—8	
Jan.	IX 1		28.2030	12.2333	+ 20	— .2	0	40 29 38.30	+ 6 43.52	+ 8	— 3	+13	22.00	—7	16.6
7	VIII 4	D	25.4233	16.6127	+ 51	—1.2	—2.6	40 32 40.81	+ 3 42.73	+ 7	— 54	+ 6	23.13	—7	16.4
	6		19.5947	16.9727	— 25	—1.4	—2.0	40 37 29.63	— 1 6.18	+ 7	— 50	— 2	23.00	—7	16.0
	7		28.3637iv	12.0083ii	— 4	0	— .2	40 29 28.38	+ 6 53.21	+ 93	— 2	+ 12	22.62	—8	16.5
	8		19.4647	20.5967	0	— .8	—2.0	40 35 54.91	+ 28.60	+ 10	— 40	+ 1	23.22	—7	
Jan.	11		13.9393	28.9560	+ 125	+ .6	— .3	40 42 42 42	— 6 19.71	+ 4	+ 6	—11	22.70	—8	16.0
13	III 6	R	15.2510	29.2470	+185	— .4	—1.4	40 42 17.65	— 5 54.08	+ 11	— 25	—10	23.33	+4	14.0
	7		22.9967	17.0877	+ 1	—2.2	—3.5	40 38 52.98	— 2 29.29	+ 6	— 82	— 4	22.89	+5	13.4
	8		16.2240	26.8410	+ 96	— .9	—1.8	40 40 52.90	— 4 28.48	+ 7	— 38	— 8	24.03	+5	13.2
	10		31.9907iv	10.5363ii	+ 12	— .6	—1.5	40 27 20.01	+ 9 2.09	+ 94	— 30	+15	22.89	+5	
	IV 1		19.7897	22.6060	20	—2.9	—2.4	40 35 13.02	+ 1 11.21	+ 8	— 80	+ 2	23.53	+5	12.9
	2		25.4753	14.0427	— 16	—1.0	—2.7	40 41 12.31	— 4 48.81	+ 5	— 52	— 8	22.95	+5	
	3		10.8807ii	30.4633iv	0	— .2	+ .2	40 44 38.09	— 8 14.77	— 79	— 1	—17	22.35	+5	13.0
	4		10.3977ii	29.0047iv	— 1	+ .8	+ .9	40 44 14.89	— 7 50.11	—1.10	+ 25	—14	23.79	+5	12.8
	5		23.0990	27.1157	+120	+ .3	+1.1	40 34 41.35	+ 1 41.78	+ 5	+ 19	+ 3	23.40	+5	
	6		23.3407	15.9843	— 13	+2.7	+1.5	40 39 27.99	— 3 5.83	+ 5	+ 65	— 5	22.81	+5	13.0
	8		28.3770	15.8753	+ 159	—3.5	—3.2	40 41 41.23	— 5 16.26	+ 7	—1.01	—11	23.92	+4	
	9		14.4763	27.2663	+ 68	—3.2	—3.9	40 31 0.95	+ 5 23.31	+ 8	—1.05	+10	23.39	+4	
	10		10.0417ii	31.3917iv	+ 5	— .5	— .9	40 27 23.63	+ 8 59.44	+ 95	— 20	+17	23.99	+4	13.0
Jan. 16	III 7	D	18.1587	24.0760	+ 40	— .2	+ .5	40 38 52.84	— 2 29.61	+ 6	+ 3	— 4	23.28	+5	10.6
	9		16.1487	27.6910	+ 132	—2.2	—3.5	40 31 31.88	+ 4 51.96	+ 11	— 82	+ 8	23.21	+5	10.0
	10		9.5723ii	31.0377iv	+ 1	+ .2	— .3	40 27 19.95	+ 9 2.35	+ 94	0	+15	23.39	+5	
	IV 1		21.0643	18.3043	— 5	+1.3	+2.8	40 35 13.05	+ 1 9.72	+ 9	+ 58	+ 2	23.46	+5	10.0
	2		15.2880	26.7350	+ 67	+ .4	0	40 41 12.35	— 4 49.39	+ 5	+ 7	— 8	23.00	+5	
	3		29.5930iv	10.0457ii	0	—1.1	—2.0	40 44 38.19	— 8 13.89	— 79	— 45	—17	22.89	+5	
	4		29.4220iv	10.7980ii	— 1	+ 6	—1.4	40 44 15.00	— 7 50.55	— 82	— 8	—14	23.41	+5	10.0
	5		25.5547	21.5713	+ 84	— .3	+ .8	40 34 41.49	+ 1 40.86	+ 5	+ 5	+ 3	22.48	+5	
	7		4.9910ii	30.3413iv	— 73	+ .4	+1.6	40 25 41.24	+10 40.32	+ 98	+ 27	+24	23.05	+4	
	8		15.0403	27.5943	+ 99	—3.9	—1.3	40 41 41.46	— 5 17.44	+ 7	— 83	—11	23.15	+4	
Jan. 17	9		25.8537	13.1320	— 39	+2.3	+1.3	40 31 1.20	+ 5 21.33	+ 8	+ 56	+10	23.27	+4	
	10		29.9500iv	8.6447ii	— 6	—1.2	— .3	40 27 23.89	+ 8 58.29	+ 95	— 24	+17	23.06	+4	9.4
	III 7	R	22.8370	16.8870	— 5	+2.6	+1.8	40 38 52.78	— 2 30.32	+ 5	+ 67	— 4	23.14	+5	13.5
	8		16.2907	26.9267	+ 100	— .6	— .9	40 40 52.81	— 4 28.97	+ 7	— 21	— 8	23.62	+5	13.2
	9		26.1460	14.6260	+ 26	+ .9	+ .7	40 31 31.87	+ 4 51.13	+ 11	+ 24	+ 8	23.43	+5	
	10		32.2473iv	10.7777ii	+ 12	—2.8	—3.1	40 27 19.94	+ 9 2.48	+ 94	— 87	+15	22.64	+5	
	IV 1		19.5190	22.2853	+ 14	0	+ .4	40 35 13.06	+ 1 9.93	+ 8	+ 5	+ 2	23.14	+5	12.4
	2		26.8300	15.3927	+ 75	—1.6	+ .8	40 41 12.36	— 4 49.16	+ 5	+ 38	— 8	23.55	+5	
	3		10.8207ii	30.3633iv	0	—2.5	—1.3	40 44 38.23	— 8 13.76	— 89	— 60	—17	22.81	+5	
	4		11.7530ii	30.4087iv	— 9	— .1	+ .8	40 44 15.05	— 7 51.32	— 82	+ 9	—14	22.86	+5	11.9

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Jan. 17	IV 5	D	21.7570	17.6357	— 6	—1.1	— .2	40 34 41.55	+ 1 41.58	+ 5	— 21	+ 3	40 36 23.00	+5	11.7
	6	R	23.6953	16.3467	0	+4.9	+4.4	40 39 28.22	— 3 5.66	+ 5	+1.40	— 5	23.96	+5	11.6
	8		28.7980	16.2130	+186	+ .4	+ .7	40 41 41.55	— 5 18.44	+ 7	+ 16	—11	23.23	+4	11.4
	9		15.1907	27.9213	+118	+1.1	+ .4	40 31 1.30	+ 5 21.95	+ 8	+ 24	+10	23.67	+4	11.3
	10		10.3440ii	31.6487iv	+ 7	+ .2	— .6	40 27 24.00	+ 8 58.30	+ 95	— 4	+17	23.38	+4	
Jan. 19	VIII 6	R	20.3207	22.9077	+ 24	—1.3	—2.0	40 37 28.61	— 1 5.42	+ 7	— 48	— 2	22.76	—7	15.8
	7		13.0997ii	29.5257iv	— 27	— .9	—2.0	40 29 27.28	+ 6 54.94	+ 93	— 41	+12	22.86	—8	15.6
	8		23.8653	22.7310	+ 22	+ .8	+ .4	40 35 53.71	+ 28.72	+ 10	+ 18	+ 1	22.72	—7	15.4
	10		4.5483ii	31.8480iv	— 79	— .7	— .4	40 47 53.38	—11 29.53	— 80	— 17	—23	22.65	—7	15.2
	11		30.1233	15.2220	+235	— .7	— .9	40 42 40.73	— 6 17.08	+ 4	— 23	—11	23.35	—8	
	IX 1		29.6023	13.4767	+146	—1.2	—1.0	40 29 35.75	+ 6 47.79	+ 8	— 33	+13	23.42	—8	15.2
	2		25.3593	18.0570	+ 75	+2.6	+2.3	40 39 27.04	— 3 4.68	+ 5	+ 74	— 5	23.10	—8	
	3		16.9310	22.9163	— 4	— .5	— .6	40 38 54.30	— 2 31.21	+ 5	— 16	— 4	22.94	—8	15.2
	4		20.3867	22.0330	+ 12	+ .6	+1.3	40 35 40.77	+ 41.63	+ 6	+ 27	+ 2	22.75	—8	15.3
	5		20.4990	23.3693	+ 33	—1.1	— .3	40 37 35.40	— 1 12.61	+ 7	— 23	— 2	22.61	—8	15.4
Jan. 20	6		22.1063	21.0553	+ 10	— .9	—1.8	40 36 49.70	— 26.58	+ 9	— 38	— 1	22.82	—7	15.5
	VIII 9	D	12.5550	26.7510	— 30	+ .7	+ .6	40 30 24.21	+ 5 58.59	+ 9	+ 19	+11	23.19	—7	13.6
	10		31.7257iv	4.4343ii	— 84	+ .6	— .3	40 47 53.31	—11 29.31	— 80	+ 6	—23	23.03	—7	
	11		13.3713	28.2967	+ 74	— .8	— .4	40 42 40.63	— 6 17.28	+ 4	— 18	—11	23.10	—8	14.5
	IX 1		11.7923	27.9093	— 15	—3.6	—2.5	40 29 35.64	+ 6 47.16	+ 8	— 94	+13	22.07	—8	14.9
	2		17.0890	24.3517	+ 32	—2.4	—2.5	40 39 26.90	— 3 3.57	+ 5	— 73	— 5	22.60	—8	
	3		21.7683	15.7853	— 42	+ .1	— .8	40 38 54.14	— 2 31.05	+ 5	— 9	— 4	23.01	—8	15.0
	5		21.1623	18.2900	— 5	— .8	— .8	40 37 35.23	— 1 12.56	+ 7	— 24	— 2	22.48	—8	
Jan. 21	6		18.1353	19.2207	— 8	0	+ .8	40 36 49.51	— 27.41	+ 9	+ 10	— 1	22.28	—7	14.4
	IV 1	D	21.2953	18.5160	— 2	0	+ .3	40 35 12.96	+ 1 10.21	+ 9	+ 4	+ 2	23.32	+5	21.0
	2		14.2420	25.7097	— 3	0	+ .6	40 41 12.29	— 4 49.72	+ 1	+ 7	— 8	22.57	+5	20.0
	3		28.6263iv	9.0660ii	+ 3	0	— .4	40 44 38.23	— 8 14.19	— 85	— 5	—17	22.97	+5	
	4		29.7127iv	11.0670ii	— 3	0	—1.2	40 44 15.09	— 7 51.07	— 88	— 15	—14	22.85	+5	
	5	R	20.6860	24.6810	+ 64	— .6	—1.1	40 34 41.67	+ 1 41.09	+ 6	— 24	+ 3	22.61	+5	20.0
	6	D	16.7987	24.1420	+ 20	— .8	—2.2	40 39 28.37	— 3 5.58	+ 3	— 42	— 5	22.35	+5	
	7		6.4533ii	31.7653iv	— 28	+1.0	+1.4	40 25 41.53	+10 39.43	+1.07	+ 35	+ 24	22.62	+4	
	8		14.2380	26.8383	+ 37	—2.8	—1.0	40 41 41.82	— 5 18.43	+ 3	— 60	—11	22.71	+4	
	9		25.6670	12.9473	— 52	—2.0	—2.8	40 31 1.60	+ 5 21.22	+ 12	— 70	+10	22.34	+4	19.5
	10		31.7440iv	10.4417ii	+ 9	—1.6	—2.3	40 27 24.34	+ 8 58.22	+1.02	— 57	+17	23.18	+4	17.1
	V 1		13.1577	28.9080	+ 95	—1.0	—2.2	40 29 44.81	+ 6 38.17	+ 13	— 45	+ 11	22.77	+4	17.0
	2		22.3887	18.5837	+ 12	— .2	— .5	40 38 24.16	— 2 1.42	+ 4	— 10	— 4	22.64	+3	
	3		31.6363iv	8.2097ii	— 2	—1.1	—1.1	40 26 30.10	+ 9 51.86	+1.09	— 33	+24	22.96	+3	
	4		27.5303	12.8060	+ 14	0	0	40 42 35.00	— 6 12.04	+ 1	0	—12	22.85	+3	
	5		6.8060ii	30.1760iv	— 30	—3.0	—3.5	40 26 32.96	+ 9 50.36	+1.04	— 96	+19	23.59	+3	16.9
	6		19.9850	21.2703	+ 5	— .5	—1.9	40 36 54.72	— 32.49	+ 12	— 33	— 1	22.01	+2	16.4
	7		27.8593	12.7413	+ 27	+ .4	—2.1	40 42 45.33	— 6 22.02	+ 2	— 20	—13	23.00	+2	
	8		22.1467	17.8430	— 1	—2.0	—2.1	40 34 34.74	+ 1 48.73	+ 9	— 61	+ 4	22.99	+2	
	9		27.9360	13.7890	+ 70	—1.8	—2.5	40 42 21.59	— 5 57.60	0	— 63	—10	23.26	+2	
Jan. 23	10		18.5333	21.9953	+ 5	— .2	— .7	40 37 50.50	— 1 27.48	+ 6	— 12	— 3	22.93	+1	16.4
	IV 1	R	19.4117	22.2067	+ 13	—1.1	+ .3	40 35 12.82	+ 1 10.64	+ 9	— 15	+ 2	23.42	+4	22.4
	2		27.3140	15.9143	+108	— .8	—2.2	40 41 12.15	— 4 48.28	+ 1	— 42	— 8	23.38	+5	
	3		12.7840ii	32.3377iv	— 9	—2.1	—2.4	40 44 38.15	— 8 13.98	— 85	— 67	—17	22.48	+4	22.7
	4		10.6033ii	29.2373iv	— 1	+ .2	+1.0	40 44 15.62	— 7 50.77	— 88	+ 16	—14	23.39	+5	21.9
	5	D	26.2417	22.2150	+101	—1.2	—1.6	40 34 41.62	+ 1 41.99	+ 7	— 41	+ 3	23.30	+5	
	7	R	34.0010iv	8.6357ii	+ 41	—3.3	—3.8	40 25 41.53	+10 40.93	+1.07	—1.05	+24	22.72	+4	21.4
	8		28.1407	15.5667	+137	—2.0	—2.7	40 41 41.84	— 5 18.01	+ 3	— 69	—11	23.06	+4	
	9		15.1527	27.8750	+115	—1.0	—1.6	40 31 1.65	+ 5 21.70	+ 12	— 37	+10	23.20	+4	21.3
Jan. 25	10		8.8033ii	30.0993iv	— 4	+ .9	+ .2	40 27 24.41	+ 8 58.01	+1.02	+ 18	+17	23.79	+4	21.4
	IV 1	D	21.0810	18.3163	— 5	+ .9	+2.2	40 35 12.68	+ 1 9.83	+ 9	+ 44	+ 2	23.06	+4	35.1
	2		14.1090	25.5707	— 10	+ .6	+1.8	40 41 12.03	— 4 49.53	+ 1	+ 33	— 8	22.76	+5	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
								′ ″					° ′ ″		
Jan. 25	IV 3	D	29.6773iv	10.1157ii	0	— .4	—1.4	10 41 38.05	— 8 14.17	— 85	— 25	—17	40 36 22.61	4	33.9
	4		29.2713iv	10.6127ii	— 1	— .2	— .8	40 44 14.91	— 7 51.36	— 88	— 14	—14	22.42	5	33.4
	5	R	19.8873	23.8797	+ 45	+ .4	—1.1	40 34 41.56	+ 1 40.97	+ 7	— 7	+ 3	22.56	5	
	6	D	13.7193	21.0650	—115	+ .6	—1.3	40 39 28.29	— 3 5.28	+ 3	— 7	— 5	22.92	5	
	7	R	33.6317iv	8.2857ii	+ 30	—1.9	—2.1	40 25 41.52	+ 10 40.45	+1.07	— 63	+ 21	22.65	4	32.9
	8	D	13.1120	25.7217	— 45	— .5	—1.3	40 41 41.85	— 5 18.51	+ 3	— 25	—11	23.01	4	32.8
	9		27.0453	14.3257	+ 50	— .9	— .9	40 31 1.67	+ 5 21.45	+ 12	— 27	+ 10	23.07	4	31.5
	10		32.5433iv	11.2580ii	+ 15	—1.3	—1.1	40 27 21.41	+ 8 57.76	+1.02	— 36	+ 17	23.03	4	
	V 1		15.6310	31.3680	+ 326	—1.0	—1.5	40 29 44.93	+ 6 38.38	+ 13	— 36	+ 11	23.19	4	31.0
	2	R	18.7130	23.4827	+ 32	—2.7	—2.0	40 38 24.32	— 2 0.57	+ 4	— 72	— 4	23.03	4	30.5
	3		10.4677ii	33.9173iv	+ 13	— .9	—2.8	40 26 30.28	+ 9 52.50	+1.09	— 51	+ 24	23.60	3	
	4		13.0760	27.7820	+ 40	—1.9	—2.5	40 42 35.22	— 6 11.61	+ 1	— 65	—12	22.85	3	
	5		32.5227iv	9.1763ii	+ 16	—2.9	—1.8	40 26 33.19	+ 9 49.82	+1.04	— 72	+ 19	23.52	3	30.1
	6		22.4213	21.1563	+ 11	—1.7	—1.3	40 36 54.96	— 31.99	+ 12	— 46	— 1	22.62	2	29.4
	7		13.1880	28.3250	+ 68	— .8	—1.1	40 42 45.61	— 6 22.57	+ 2	— 27	—13	22.66	2	29.2
	8		20.0267	21.3103	+ 55	—2.1	—3.2	40 31 35.05	+ 1 48.35	+ 9	— 77	+ 4	22.76	2	
	9		11.0110	28.1777	— 92	—1.8	—2.0	40 42 21.93	— 5 58.12	0	— 56	—10	23.15	2	
Jan. 26	10		21.2056	20.7810	+ 50	— .8	— .9	40 37 50.84	— 1 26.61	+ 6	— 25	— 3	23.98	2	28.5
	IV 1	R	19.2053	21.9907	+ 10	+ .9	— .8	40 35 12.63	+ 1 10.39	+ 9	+ 26	+ 2	23.39	4	35.0
	2		25.9247	14.5327	+ 12	—1.3	—2.1	40 41 11.97	— 4 47.82	+ 1	— 49	— 8	23.59	5	
	3		12.0217ii	31.5887iv	— 5	+ .5	+ .5	40 41 38.02	— 8 14.22	— 85	+ 15	—17	22.93	4	
	4		11.7910ii	30.4253iv	— 10	—1.7	— .3	40 44 14.91	— 7 50.64	— 88	— 33	—14	22.92	5	34.5
	5	D	25.5883	21.6133	— 85	+ 3.0	+ 1.5	40 34 41.51	+ 1 40.63	+ 7	+ 70	+ 3	22.97	5	
	6	R	23.4523	16.0623	— 10	+ 4.2	+ 3.6	40 39 28.28	— 3 6.66	+ 3	+ 1.18	— 5	22.78	5	
	7		33.2347iv	7.9040ii	+ 17	— .7	+ .2	40 25 41.52	+ 10 39.95	+1.07	— 9	+ 24	22.69	4	
	8		27.9287	15.3530	+ 122	— .6	— .8	40 41 41.86	— 5 18.00	+ 3	— 20	—11	23.58	4	
	10		8.9470ii	30.2343iv	— 2	— .2	— .2	40 27 24.46	+ 8 57.76	+1.02	— 6	+ 17	23.35	4	33.4
	V 1		28.8470	13.0970	+ 90	— .1	—1.6	40 29 44.96	+ 6 38.11	+ 13	— 22	+ 11	23.09	4	
	2		18.4637	23.2117	+ 21	— 2.0	—1.8	40 38 24.36	— 2 0.76	+ 4	— 57	— 4	23.03	4	31.6
	3		10.2647ii	33.7016iv	+ 40	—2.2	—2.3	40 26 30.32	+ 9 52.15	+1.09	— 67	+ 24	23.13	3	31.2
	4		13.9177	28.6317	+ 110	— .4	— .2	40 42 35.26	— 6 11.99	+ 1	— 9	—12	23.07	3	
	5		31.4497iv	8.0943ii	— 4	—2.5	—1.2	40 26 33.21	+ 9 50.00	+1.04	— 58	+ 19	23.89	3	*a*
	6		21.9147	20.6853	+ 9	—2.4	—3.1	40 36 55.00	— 31.08	+ 12	— 81	— 1	23.22	2	30.4
	7		12.7787	27.9013	— 31	—1.8	—1.7	40 42 45.66	— 6 22.19	+ 2	— 52	—13	22.84	2	30.0
	8		19.6220	23.8993	+ 41	—1.0	—1.8	40 34 35.11	+ 1 48.16	+ 9	— 40	+ 4	23.00	2	
	9		13.2710	27.4623	+ 31	—2.0	—1.6	40 42 22.00	— 5 58.58	0	— 54	—10	22.78	2	
Feb. 3	10		22.7943	19.3463	+ 22	—2.3	—1.8	40 37 50.91	— 1 27.16	+ 6	— 62	— 3	23.16	2	30.5
	IX 1	R	28.1327	11.9563	+ 5	—2.0	—3.1	40 29 34.49	+ 6 48.69	+ 14	— 74	+ 13	22.71	8	22.6
	2		24.4433	17.2520	+ 35	— .9	— .6	40 39 25.30	— 3 1.77	+ 3	— 23	— 5	23.28	9	
	3		17.7793	23.6867	+ 26	— .9	— .5	40 38 52.42	— 2 29.31	+ 4	— 22	— 4	22.89	9	21.6
	4		19.8113	21.5977	+ 6	—1.3	—2.0	40 35 38.63	— 45.15	+ 7	— 48	+ 2	23.39	9	
	5		20.9707	23.7515	+ 40	+ .2	— .5	40 37 33.24	— 1 10.35	+ 6	— 3	— 2	22.90	8	21.5
	6		21.8020	20.8523	+ 7	—1.8	—1.3	40 36 47.41	— 24.01	+ 9	— 47	— 1	23.01	8	
	7		8.4650ii	31.9930iv	+ 5	—2.0	—2.6	40 46 17.89	— 9 54.42	— 90	— 67	—17	21.73	9	
	X 1		27.4873	15.2263	+ 100	—1.4	—2.1	40 41 33.17	— 5 10.01	+ 1	— 51	— 9	22.57	9	20.3
	2		32.6383iv	12.2980ii	+ 3	+ .4	—1.4	40 27 48.37	+ 8 33.89	+1.03	— 11	+ 17	23.35	8	21.1
Feb. 4	3		21.6017	18.6603	+ 3	+ .7	+ .2	40 35 8.63	+ 1 14.39	+ 7	+ 14	+ 2	23.25	9	19.8
	IV 3	D	29.3056iv	9.8063ii	— 1	—3.2	—4.5	40 44 37.82	— 8 12.63	— 85	—1.12	—17	23.05	4	18.2
	4		29.0217iv	10.4233ii	+ 2	—2.5	—2.4	40 44 14.76	— 7 49.90	— 88	— 73	—14	23.11	4	17.6
	5	R	17.5200	21.5137	— 13	0	— .4	40 34 41.52	+ 1 40.87	+ 7	— 5	+ 3	22.44	4	17.3
	6	D	16.0067	23.3610	— 12	— .2	+ .6	40 39 28.33	— 3 5.78	+ 3	+ 4	— 5	22.57	4	
	7		4.8060ii	30.0850iv	— 80	+ 1.7	+ 2.3	40 25 41.74	+ 10 38.47	+1.07	+ 58	+ 24	22.10	4	
	8		14.0607	26.7093	+ 29	+ .1	+ .9	40 41 42.19	— 5 19.64	+ 3	+ 13	—11	22.60	4	17.2
	9		28.3160	15.6383	+ 147	— .8	— .5	40 31 2.10	+ 5 20.68	+ 12	— 20	+ 10	22.80	4	
	10		30.4320iv	9.1690ii	— 2	— .2	+ .7	40 27 24.95	+ 8 57.20	+1.02	+ 5	+ 17	23.39	4	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Feb. 4	V 1		13.5540	29.2623	+130	+ .1	+ .9	40 29 45.49	+ 6 37.20	+ 13	+ 13	+11	40 36 23.06	+4	16.1
	2		23.5250	18.6633	+ 32	+2.6	+3.0	40 38 25.01	— 2 2.91	+ 4	+ 83	— 4	22.93	+4	16.2
	3		29.6113iv	6.2623ii	— 40	+1.2	+2.6	40 26 31.03	+ 9 49.81	+1.09	+ 54	+24	22.71	+3	
	4		27.7517	12.9667	+ 33	+1.1	+1.7	40 42 36.03	— 6 13.63	+ 1	+ 41	—12	22.70	+3	
	5		8.3877ii	31.6563iv	+ 1	+ .4	0	40 26 34.04	+ 9 47.88	+1.04	+ 7	+19	23.22	+3	16.2
	6		19.2107	20.5457	— 1	+2.0	+1.8	40 36 55.85	— 33.73	+ 12	+ 57	— 1	22.80	+2	
	7		26.7983	11.6107	— 72	—1.3	— .3	40 42 46.57	— 6 23.53	+ 2	— 26	—13	22.67	+2	16.2
	8		21.6960	17.4847	— 11	+1.0	+1.0	40 34 36.07	+ 1 46.37	+ 9	+ 30	+ 4	22.87	+2	
	9		28.4450	14.1523	+110	+1.4	+2.5	40 42 23.06	— 6 1.37	0	+ 56	—10	22.15	+2	
	10		14.9767	18.5687	— 69	+2.3	+3.2	40 37 51.97	— 1 30.58	+ 5	+ 80	— 3	22.21	+2	15.0
	IX 1	D	12.2593	28.4280	+ 33	+ .7	+ .4	40 29 34.49	+ 6 48.63	+ 14	+ 17	+13	23.56	—8	9.4
	2		16.0597	23.2403	— 15	—2.3	—1.7	40 39 25.26	— 3 1.39	+ 3	— 61	— 5	23.24	—9	
	3		22.1013	16.2093	— 30	— .8	— .8	40 38 52.37	— 2 28.79	+ 4	— 24	— 4	23.34	—9	10.4
	4		21.2483	19.5007	+ 4	— .7	0	40 35 38.57	+ 44.16	+ 7	— 12	+ 2	22.70	—9	
	5		21.0953	18.3337	— 5	—1.1	— .2	40 37 33.16	— 1 9.77	+ 6	— 21	— 2	23.22	—8	
	6		19.4767	20.4150	+ 1	—2.2	—2.7	40 36 47.33	— 23.71	+ 9	— 72	— 1	22.98	—8	
	7		32.4927iv	8.9647ii	+ 16	+2.1	+1.1	40 46 17.78	— 9 54.50	— 90	+ 50	—17	22.71	—9	10.6
	X 1		13.7760	26.0483	— 7	— .4	+ .8	40 41 33.06	— 5 10.06	+ 1	+ 3	— 9	22.95	—9	10.3
	3		19.2080	22.1943	+ 12	—1.7	—3.0	40 35 8.50	+ 1 15.48	+ 7	— 67	+ 2	23.40	—9	9.5
	4		10.2317ii	25.7737iv	+ 51	—2.8	—3.1	40 29 50.11	+ 6 32.82	+1.00	— 87	+11	23.17	—9	
Feb. 8	IV 5	D	25.9697	21.9030	+ 94	— .8	—1.9	40 34 41.21	+ 1 42.98	+ 7	— 38	+ 3	23.91	+4	23.5
	6	R	24.0167	16.7027	+ 14	0	+ .4	40 39 28.06	— 3 4.82	+ 3	+ 5	— 5	23.27	+4	
	7		33.0930iv	7.6940ii	+ 12	—5.9	—5.4	40 25 41.56	+10 41.71	+1.07	—1.70	+24	22.88	+3	
	8		27.2680	14.6607	+ 73	+ .3	— .3	40 41 42.04	— 5 18.69	+ 3	+ 1	—11	23.28	+4	23.4
	9		14.6763	27.4040	+ 79	— .1	—1.0	40 31 2.00	+ 5 21.75	+ 12	— 14	+10	23.83	+4	
	10		11.3553ii	32.6403iv	+ 15	— .4	+ .2	40 27 24.89	+ 8 57.78	+1.02	— 4	+17	23.82	+4	
	V 1		28.9207	13.2000	+ 98	—1.9	—1.1	40 29 45.45	+ 6 37.42	+ 13	— 46	+11	22.65	+4	
	2		18.2917	23.1163	+ 20	—1.5	—1.7	40 38 25.03	— 2 1.94	+ 4	— 47	— 4	22.62	+4	22.4
	4		14.4863	29.2133	+160	0	— .5	40 42 36.11	— 6 12.46	+ 1	— 7	—12	23.47	+3	21.4
	5		32.5750iv	9.1757ii	+ 18	— .8	— .2	40 26 34.14	+ 9 48.68	+1.04	— 16	+19	23.89	+3	
	6		21.3487	20.0540	+ 5	—3.8	—3.3	40 36 56.00	— 32.73	+ 12	—1.07	— 1	22.31	+2	21.4
	7		13.6877	28.8563	+114	—2.0	— .9	40 42 46.75	— 6 23.50	+ 2	— 45	—13	22.69	+3	20.4
	8		19.4137	23.6513	+ 39	+ .8	— .9	40 34 36.28	+ 1 47.16	+ 9	+ 2	+ 4	23.59	+2	20.4
	9		13.7503	27.9873	+ 73	—1.7	—1.3	40 42 23.32	— 5 59.87	0	— 46	—10	23.89	+2	
	10		23.4943	19.9990	+ 37	—3.1	—2.6	40 37 52.23	— 1 28.39	+ 6	— 86	— 3	23.01	+2	20.4
Feb. 11	IX 1	R	29.0157	12.8837	+ 90	+1.0	+ .6	40 29 34.43	+ 6 47.78	+ 14	+ 24	+13	22.72	—8	25.9
	2		23.9333	16.6923	+ 12	+5.2	+4.1	40 39 25.04	— 3 2.97	+ 3	+1.41	— 5	23 46	—9	
	3		17.5740	23.5037	+ 19	+2.4	+2.5	40 38 52.09	— 2 29.85	+ 4	+ 73	— 4	22.97	—9	
	4		19.9993	21.7587	+ 9	+ .5	+1.3	40 35 38.19	+ 44.47	+ 7	+ 25	+ 2	23.00	—9	25.9
	5		20.2013	22.9553	+ 28	+ .6	+ .8	40 37 32.74	— 1 9.65	+ 6	+ 20	— 2	23.33	—8	
	6		22.6480	21.6907	+ 12	— .2	— .3	40 36 46.84	— 24.21	+ 9	— 7	— 1	22.64	—8	
	7		9.3390ii	32.8047iv	+ 22	— .2	0	40 46 17.22	— 9 52.88	— 90	— 3	—17	23.24	—9	
	X 1		27.7123	15.4867	+116	— .6	—1.4	40 41 32.39	— 5 9.16	+ 1	— 28	— 9	22.87	—9	25.3
	2		32.4233iv	12.0673ii	+ 7	+ .5	+2.1	40 27 47.58	+ 8 34.28	+1.03	+ 35	+17	23.41	—8	
	3		22.6990	19.6973	+ 23	—1.7	—1.4	40 35 7.74	+ 1 15.89	+ 7	— 47	+ 2	23.25	—9	
	4		29.3170iv	13.7620ii	— 41	+ .6	— .1	40 29 49.30	+ 6 32.87	+1.00	+ 8	+11	23.36	—9	
Feb. 14	5		11.5110ii	32.2990iv	+ 11	— .8	+ .1	40 45 69.18	— 8 45.21	— 84	— 12	—20	22.81	—8	24.8
	IV 7	D	6.5170ii	31.8277iv	— 27	+3.0	+4.7	40 25 41.51	+10 39.32	+1.07	+1.11	+24	23.25	+3	36.7a
	8		12.3573	25.0070	— 97	+2.1	+1.2	40 41 42.05	— 5 19.30	+ 3	+ 51	—11	23.18	+4	35.6
	9		26.8137	14.1383	+ 35	+1.8	+1.2	40 31 2.05	+ 5 20.29	+ 12	+ 46	+10	23.02	+4	34.9
	10		32.9030iv	11.6937ii	+ 16	+1.5	+2.1	40 27 25.00	+ 8 55.82	+1.02	+ 52	+17	22.53	+4	
	V 1		14.3920	30.0590	+205	+1.6	+1.6	40 29 45.58	+ 6 36.29	+ 13	+ 48	+11	22.59	+4	34.9
	2		23.3443	18.4970	+ 27	+ .4	+ .4	40 38 25.24	— 2 2.52	+ 4	+ 12	— 4	22.84	+4	
	3		31.2530iv	7.8800ii	— 9	+ .1	—1.4	40 26 31.36	+ 9 50.41	+1.09	— 16	+24	22.94	+3	34.6
	4		28.1933	13.4490	+ 72	+1.0	+ .1	40 42 36.41	— 6 12.65	+ 1	+ 18	—12	23.83	+3	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Feb. 14	V 5	D	8.8837ii	32.1343iv	+ 9	-+ .8	+ 1.6	40 26 31.47	+ 9 47.37	+1.04	+ 34	+19	40 36 23.41	+ 3	31.2
	6		19.6917	21.0487	0	-+ 1.4	+ 1.9	40 36 56.38	— 34.28	-+ 12	+ 48	- 1	22.69	+3	34.3
	7		27.8197	12.6137	+ 18	+ .5	+- .3	40 42 47.17	— 6 24.17	+- 2	+ 12	—13	23.01	+ 3	33.4
	8		24.5803	20.3940	+- 59	+- .2	-+ .5	40 34 36.75	+- 1 45.91	-+ 9	+ 10	-+ 4	22.89	+ 2	
	9		30.6147	16.3943	+-296	0	— .2	40 42 23.84	— 6 0.74	0	— 2	—10	22.98	-+ 3	
Feb. 15	10		21.2217	24.7803	+ 65	-+2.2	+ 1.8	40 37 52.77	— 1 30.06	+- 5	+ 60	— 3	23.33	-+2	33.2
	VI 1	R	28.7187	13.0527	+ 82	+2.4	+-2.5	40 29 45.62	-+ 6 35.91	+ 13	-+ 73	+11	22.53	+ 4	43.8
	2		18.7917	23.6767	+ 37	-+ 2.2	+-2.8	40 38 25.25	— 2 3.49	+ 4	+ 73	— 4	22.49	+ 3	43.1
	4		14.3817	29.1473	-+154	+ .9	+ 2.3	40 42 36.48	— 6 13.37	+- 1	+ 45	—12	23.45	-+3	
	5		33.2690iv	10.0053ii	-+ 31	—1.5	— .8	40 26 31.55	+ 9 47.73	-+1.04	— 36	+19	23.15	+ 3	
	6		22.2247	20.8870	+- 12	-+1.2	+ .3	40 36 56.48	— 33.83	+ 12	-+ 24	— 1	23.01	-+3	43.1
	7		13.2613	28.4960	+ 79	+1.5	+-2.2	40 42 47.27	— 6 25.03	-+ 2	-+ 54	—13	22.67	+3	42.5
	8		19.9103	21.1350	+- 50	- .3	— .2	40 34 36.85	+- 1 46.08	+- 9	— 7	+ 4	22.99	-+2	
	9		14.8610	29.1597	-+170	-+1.4	+-1.0	40 42 23.96	— 6 1.62	0	+- 37	—10	22.61	-+3	42.5
	IX 1	D	11.5330	27.6850	— 37	-+1.0	0	40 29 31.39	+- 6 47.93	+ 14	+ 17	+ 13	22.75	—8	38.6
	2		16.3617	23.5427	— 2	— .4	—1.6	40 39 24.88	— 3 1.39	+- 3	— 27	— 5	23.20	—8	38.4
	3		22.2520	16.3820	— 23	-+ .3	+- .2	40 38 51.90	— 2 28.23	+ 4	+ 7	- 4	23.74	—8	37.8
	4		20.6230	18.8373	— 2	— .6	— .3	40 35 37.91	+ 45.10	+ 7	— 14	+- 2	22.96	—9	37.8
	5		20.5897	17.8287	— 13	— .8	—1.1	40 37 32.43	— 1 9.71	+ 6	— 27	— 2	22.49	—8	
	X 1		12.8333	25.0670	— 76	—1.6	—2.0	40 41 31.94	— 5 8.85	+- 1	— 53	— 9	22.48	—9	37.3
	2		9.2187ii	29.6240iv	0	—1.2	—1.4	40 27 47 11	-+ 8 35.46	+ 1.03	— 38	+17	23.39	—8	
	3		18.8747	21.9240	-+ 7	— .7	—1.2	40 35 7.22	+ 1 17.04	+ 7	— 27	+ 2	24.08	—9	
	4		11.6780ii	27.2410iv	-+ 15	+ .2	— .7	40 29 48.74	+- 6 33.25	++1.00	— 5	+ 11	23.05	—9	
	5		28.1173iv	7.3623ii	— 10	0	— .8	40 45 8.65	— 8 41.27	— 81	— 10	—20	23.24	—8	
	6		21.3340	16.7070	— 28	— .8	—1.6	40 34 26.28	-+ 1 56.82	+- 9	— 31	+ 4	22.89	—8	36.7
Feb. 16	IX 2	R	23.7177	16.5097	+- 4	-+2.5	-+2.4	40 39 24.88	— 3 2.11	+- 3	+- 73	— 5	23.48	—8	25.0
	3		16.5867	22.4917	— 16	-+1.1	++1.8	40 38 51.90	— 29.14	-+ 4	+- 42	— 4	23.18	—8	25.0
	4		19.5460	21.2667	-+ 4	+ 2.0	++2.5	40 35 37.89	+- 43.48	+ 7	+ 66	+ 2	22.12	—9	24.4
	5		19.0867	21.8707	+ 8	+ .5	+-2.6	40 37 32.40	— 1 10.35	-+ 6	-+ 42	— 2	22.51	—8	24.0
	6		21.6343	20.6843	+ 8	+ .9	-+ .5	40 36 46.44	— 21.02	+- 9	-+ 22	— 1	22.72	—8	
	7		7.4790ii	30.9450iv	— 17	+ .6	+-2.2	40 46 16.79	— 9 52.79	— 89	+ 38	—17	23.32	—9	
	X 1		26.7107	14.4337	+ 40	++2.0	-+3.3	40 41 31.87	— 5 10.26	-+ 1	+ 76	— 9	22.29	—9	23.7
	3		22.7013	19.7043	+- 21	+ 2.6	++4.2	40 35 7.13	+- 1 15.77	+- 7	+ 98	+- 2	23.97	—9	23.5
	4		30.1147iv	14.5907ii	— 63	-+3.1	-+4.5	40 29 48.65	+ 6 32.03	+ 99	-+1.11	-+11	22.89	—9	
	6		18.6770	23.2500	-+ 28	+1.1	+ 1.2	40 31 26.16	+ 1 55.60	+ 9	+ 34	-+ 4	22.23	—8	23.4
Feb. 20	V 1	D	12.0183	27.7407	— 10	+- .7	0	40 29 45.54	+ 6 37.20	+ 17	+ 12	-+11	23.14	-+4	16.5
	2		23.1290	18.2847	+- 21	— .7	—1.4	40 38 25.30	— 2 2.45	-+ 3	— 30	— 4	22.54	++3	
	3		31.6903iv	8.3263ii	0	—2.0	— .2	40 26 31.52	+ 9 50.29	-+1.14	— 36	+ 24	22.83	+ 3	15.9
	4		29.0517	14.2730	+ 145	+-1.0	+ .6	40 42 36.61	— 6 13.75	— 4	-+ 24	—12	22.94	+-3	
	5		8.6963ii	31.9570iv	+- 7	—1.6	—1.4	40 26 34.71	+- 9 47.70	+-1.09	— 45	+ 19	23.24	++3	
	6		19.0333	20.4210	— 2	— .4	-+1.2	40 36 56.70	— 35.06	+- 12	+ 8	— 1	21.83	+ 3	15.6
	7		27.2217	11.9657	- 35	+ .6	+-1.4	40 42 47.53	— 6 25.35	— 3	-+ 28	—13	22.30	++3	
	8		21.9173	17.7567	— 5	— .2	+ .5	40 34 37.17	+- 1 45.10	+- 10	+ 3	+ 4	23.44	-+2	
	9		28.4523	14.1320	-+110	-+2.9	++1.5	40 42 24.33	— 6 2.08	— 4	+- 69	—10	22.80	+ 3	
	10		18.3837	21.9803	-+ 4	+ .4	+- .4	40 37 53.28	— 1 30.88	+ 4	+- 12	— 3	22.53	-+3	15.5
	VI 1		16.5360	24.7137	+ 29	+- .1	+ 1 3	40 32 55.60	+ 3 26.68	-+ 13	+ 18	+- 6	22.65	+ 2	15.3
	2		23.8983	17.3273	++ 22	—2.0	—1.7	40 33 37.20	-+ 2 46.07	+ 11	— 56	-+ 5	22.87	++2	
	3		29.3100	12.9653	+-110	—2.2	—2.4	40 43 17.08	— 6 53.23	— 5	— 68	—13	22.99	-+2	
	4		23.6360	17.5713	-+ 21	—1.1	— .2	40 33 50.06	-+ 2 33.28	+ 10	— 21	+ 4	23.27	-+2	
	5		24.2613	18.5700	+- 49	—1.1	—1.0	40 38 46.77	— 2 23.91	+- 3	— 32	— 5	22.52	-+1	
	6		8.8623ii	29.9130iv	— 4	++ .3	— .4	40 27 29.48	+ 8 51.83	+ 1.08	0	+19	22.58	-+1	
	7		22.2410	19.5787	++ 13	+ .4	— .2	40 37 30.58	— 1 7.29	+ 4	+- 4	— 2	23.35	-+1	
	8		13.3650	29.8467	-+154	+-1.1	-+1.6	40 43 19.64	— 6 56.80	— 5	+ 40	—13	23.06	+ 1	14.9
	9		29.3440iv	9.6343ii	— 61	—2.3	—1.6	40 28 4.21	+ 8 17.81	+-1.05	- 59	-+15	22.63	0	
	10		23.7393	17.9333	+- 29	—1.4	— .8	40 33 56.83	+ 2 26.76	+ 10	— 31	+- 4	23.39	0	15.5

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
Feb.								° ′ ″					° ′ ″		
20	VI 11	D	13.6843	26.2473	0	+ .8	+ .8	40 31 6.08	+ 5 17.41	+ 16	+ 24	+10	40 36 23.99	0	
Feb.	12		30.4503	9.0823	— 29	— .1	0	40 27 22.10	+ 8 59.79	+ 23	— 1	+18	22.29	—1	14.3
24	V 1	R	26.2410	10.5270	—150	+ .7	+ .9	40 29 45.39	+ 6 36.58	+ 17	+ 23	+11	22.48	+3	33.2
	2		18.3220	23.1693	+ 22	— .7	— .8	40 38 25.21	— 2 2.51	+ 3	— 22	— 4	22.47	+3	32.9
	3		9.7937[II]	33.1600[IV]	+ 30	— .2	—2.1	40 26 31.49	+ 9 50.35	+1.13	— 30	+24	22.91	+3	
	4		13.9900	28.7470	+120	—1.3	— .3	40 42 36.56	— 6 13.09	— 4	— 26	—12	23.05	+3	
Feb.	5		33.3020[IV]	10.0470[II]	+ 33	— .1	+ .8	40 26 34.70	+ 9 47.55	+1.08	+ 9	+19	23.61	+3	32.6
25	IX 4	D	20.6003	18.7913	— 2	—2.0	—1.9	40 35 38.01	+ 45.70	+ 7	— 58	+ 2	23.22	—9	26.1
	5		20.1780	17.4470	— 20	—2.3	—2.7	40 37 32.43	— 1 8.94	+ 5	— 74	— 2	22.78	—8	
	6		18.5430	19.4633	— 5	—2.3	—2.6	40 36 46.38	— 23.23	+ 8	— 72	— 1	22.50	—8	
	7		32.3847[IV]	8.9740[II]	+ 15	—2.5	—2.2	40 46 16.70	— 9 51.47	— 93	— 71	—17	23.42	—9	
	X 1		14.2620	26.4707	+ 26	—1.3	—2.5	40 41 31.64	— 5 8.49	— 3	— 54	— 9	22.49	—9	25.9
	2		10.7317[II]	31.1507[IV]	0	—2.2	—2.9	40 27 46.75	+ 8 35.85	+1.05	— 75	+17	23.07	—8	
	3		16.6893	19.7503	— 32	—1.4	—2.3	40 35 6.77	+ 1 17.25	+ 8	— 53	+ 2	23.59	—9	25.0
	4		13.5427[II]	29.1283[IV]	— 34	— .7	—1.8	40 29 48.23	+ 6 33.65	+1.00	— 35	+11	22.64	—9	25.0
	5		31.9417[IV]	11.2273[II]	+ 8	—1.5	—2.7	40 45 8.11	— 8 43.33	— 86	— 60	—20	23.12	—8	
	6		22.3937	17.7497	+ 2	—1.7	—1.7	40 34 25.53	+ 1 57.33	+ 10	— 51	+ 4	22.49	—9	
	7		14.9883	26.4310	+ 47	— .9	—2.0	40 31 33.62	+ 4 49.20	+ 14	— 41	+ 8	22.63	—9	
Feb.	8		29.7397	10.0820	— 14	— .8	—1.7	40 44 39.94	— 8 16.58	— 8	— 35	—15	22.78	—9	
26	V 1	D	12.3153	28.0330	+ 16	— .9	— .7	40 29 45.28	+ 6 37.10	+ 17	— 24	+11	22.42	+3	30.6
	3		30.2997[IV]	6.9163[II]	— 28	—1.6	—2.5	40 26 31.53	+ 9 50.66	+1.11	— 60	+24	22.94	+3	
	4		27.4153	12.6407	+ 2	— .3	— .1	40 42 36.61	— 6 13.25	— 4	— 6	—12	23.14	+3	
	5		7.0743[II]	30.3373[IV]	— 25	+ .7	— .7	40 26 34.76	+ 9 47.62	+1.06	+ 3	+19	23.66	+3	30.4
	6		22.4760	21.1527	+ 17	+ .8	—1.0	40 36 56.82	— 33.47	+ 12	0	— 1	23.46	+3	
	7		12.6973	27.9343	+ 28	—1.0	— .2	40 42 47.68	— 6 24.99	— 3	— 19	—13	22.34	+3	30.2
	8		21.1233	25.2770	+ 79	+1.4	0	40 34 37.37	+ 1 45.13	+ 10	+ 24	+ 4	22.88	+3	
	9		13.2987	27.5787	+ 38	—2.2	—3.5	40 42 24.59	— 6 0.84	— 4	— 82	—10	22.79	+3	
	10		23.2047	19.6333	+ 29	+ .1	— .3	40 37 53.56	— 1 30.30	+ 4	— 2	— 3	23.25	+3	30.5
	VI 1		26.1853	17.9843	+102	— .8	— .3	40 32 55.91	+ 3 27.43	+ 13	— 17	+ 6	23.36	+3	
	2		18.5827	25.0970	+ 71	+1.6	+ .7	40 33 37.56	+ 2 44.75	+ 11	+ 36	+ 5	22.83	+2	
	3		12.0590	28.4413	+ 24	—1.2	+ .3	40 43 17.46	— 6 53.92	— 5	— 16	—13	23.20	+2	
	4		18.2120	24.2380	+ 44	— .6	—1.2	40 33 50.51	+ 2 32.35	+ 10	— 25	+ 4	22.75	+2	29.7
	5		18.5180	24.2187	+ 46	0	+ .1	40 38 47.22	— 2 24.13	+ 3	+ 1	— 5	23.08	+2	
	6		32.1630[IV]	11.1103[II]	+ 10	— .3	— .8	40 27 29.92	+ 8 51.87	+1.05	— 15	+19	22.88	+1	
	7		19.0367	21.7020	+ 8	—1.7	—1.8	40 37 31.12	— 1 7.35	+ 4	— 52	— 2	23.27	+1	
	8		28.8280	12.3463	+ 56	— .7	—1.3	40 43 20.19	— 6 56.51	— 5	— 29	—13	23.21	+1	
	9		11.2593[II]	30.9410[IV]	— 3	+ .8	— .4	40 28 4.78	+ 8 17.21	+1.02	+ 8	+15	23.24	+1	29.5
	10		18.5827	24.3290	+ 49	+1.8	+ .5	40 33 57.44	+ 2 25.29	+ 9	+ 37	+ 4	23.23	+1	
	11		27.8710	15.3837	+120	— .9	—1.2	40 31 6.75	+ 5 15.77	+ 16	— 31	+10	22.47	0	
	12		11.4043	32.7450	+261	+ .2	— .7	40 27 22.71	+ 8 59.68	+ 23	— 5	+18	22.75	0	29.1
	IX 4	R	19.3803	21.1673	+ 2	—1.5	—1.7	40 35 38.00	+ 45.15	+ 7	— 47	+ 2	22.77	—9	25.6
	5		19.6880	22.4770	+ 20	— .3	— .6	40 37 32.41	— 1 10.51	+ 5	— 12	— 2	21.81	—8	
	6		24.3017	23.3807	+ 17	+1.1	+ .2	40 36 46.35	— 23.31	+ 8	+ 21	— 1	23.32	—8	
	7		9.4877[II]	32.9343[IV]	+ 23	+ .2	+1.0	40 46 16.67	— 9 52.40	— 92	+ 16	—17	23.34	—9	25.3
	X 1		26.8453	14.6623	+ 54	— .5	— .2	40 41 31.60	— 5 7.93	— 3	— 11	— 9	23.44	—9	
	2		31.9047[IV]	11.5207[II]	+ 5	— .2	+1.2	40 27 46.70	+ 8 34.99	+1.04	+ 12	+17	23.02	—8	
	3		22.8323	19.8053	+ 23	— .8	0	40 35 6.71	+ 1 16.53	+ 8	— 13	+ 2	23.21	—9	
	5		10.4587[II]	31.1700[IV]	+ 2	— .7	— .5	40 45 8.03	— 8 43.25	— 85	— 18	—20	23.55	—8	24.6
	6		19.0450	23.7043	+ 38	— .6	—1.3	40 34 25.44	+ 1 57.81	+ 10	— 27	+ 4	23.12	—9	
	7		27.4363	15.9707	+116	— .9	—1.1	40 31 33.52	+ 4 49.95	+ 14	— 29	+ 8	23.40	—9	24.2
Mar.	8		10.6640	30.3123	+ 55	+ .2	+ .2	40 44 39.82	— 8 16.52	— 8	+ 6	—15	23.13	—9	23.9
1	V 2	D	22.8913	18.0143	+ 13	+1.9	+2.2	40 38 25.28	— 2 3.23	+ 3	+ 61	— 4	22.65	+3	34.9
	3		30.1820[IV]	6.8667[II]	— 28	+1.1	+1.9	40 26 31.65	+ 9 48.92	+1.11	+ 43	+24	22.35	+3	
	4		29.1017	14.3083	+147	+2.3	+2.5	40 42 36.74	— 6 14.08	— 4	+ 71	—12	23.21	+3	
	5		8.1820[II]	31.4187[IV]	— 4	+1.1	+1.4	40 26 34.90	+ 9 46.99	+1.06	+ 37	+19	23.51	+3	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
Mar.								° ′ ″					° ′ ″		
1	V 6		20.4650	21.8460	+ 10	— 2	— .8	40 36 57.01	— 34.91	+ 12	— 14	— 1	40 36 22.07	+ 3	34.4
	7		27.9883	12.7530	+ 33	+1.3	+ .4	40 42 47.89	— 6 24.95	— 3	+ 27	—13	23.05	+ 3	
	8		21.4797	17.3397	— 16	+2.5	+2.3	40 34 37.61	+ 1 44.54	+ 10	+ 72	+ 4	23.01	+3	
	9		27.6783	13.3567	+ 44	+2.2	+ .9	40 42 24.85	— 6 1.90	— 4	+ 49	—10	23.30	3	
	10		18.0240	21.6593	— 3	+2.6	+3.3	40 37 53.84	— 1 31.83	+ 4	+ 87	— 3	22.89	+ 3	
	VI 1		15.6463	23.8333	— 14	+ .4	— .2	40 32 56.21	+ 3 26.79	+ 13	+ 4	+ 6	23.23	+3	33.6
	2		24.5393	18.0423	+ 49	+2.2	+2.4	40 33 37.89	+ 2 44.25	+ 11	+ 68	+ 5	22.98	+3	33.8
	3		27.2347	10.8310	— 93	—1.6	—1.1	40 43 17.79	— 6 54.15	— 5	— 41	—13	23.05	+2	
	4		22.2253	16.2377	— 27	+1.9	+2.0	40 33 50.89	+ 2 31.19	+ 10	+ 58	+ 4	22.80	+2	33.8
	5		23.3763	17.6220	+ 17	+1.8	+ .4	40 38 47.61	— 2 25.40	+ 3	+ 35	— 5	22.54	+2	
	6		10.9857[ii]	32.0203[iv]	+ 9	— .6	— .4	40 27 30.29	+ 8 51.39	+ 1.05	— 15	+ 19	22.77	+ 2	
	IX 6	D	17.6657	18.6057	— 11	— .6	— .4	40 36 46.32	— 23.72	+ 8	— 15	— 1	22.52	—8	32.3
	7		32.5990[iv]	9.1590[ii]	+ 18	+ .3	— .9	40 46 16.64	— 9 52.19	— 92	— 6	—17	23.30	—9	32.3
	X 1		13.5987	25.8327	— 22	—1.3	—1.3	40 41 31.51	— 5 9.00	— 3	— 39	— 9	22.00	—9	31.1
	2		9.5403[ii]	29.9260[iv]	0	0	+ .4	40 27 46.58	+ 8 34.99	+1.04	+ 5	+17	22.83	—8	
	3		19.3247	22.3503	+ 16	0	+ .5	40 35 6.58	+ 1 16.48	+ 8	+ 6	+ 2	23.22	—9	
	4		12.7807[ii]	28.3507[iv]	— 16	+1.9	+1.8	40 29 48.01	+ 6 33.29	+ 99	+ 55	+11	22.95	—9	
	5		30.0800[iv]	9.3513[ii]	— 2	+1.2	+1.1	40 45 7.86	— 8 43.65	— 85	+ 34	—20	23.50	—8	
	6		22 6023	17.9747	+ 8	+ .6	+ .2	40 34 25.20	+ 1 56.92	+ 10	+ 12	+ 4	22.38	—9	
	7		14.2420	25.6970	— 4	+1.0	— .5	40 31 33.24	+ 4 49.37	+ 14	+ 10	+ 8	22.93	—9	29.8
	8		29.5557	9.8980	— 31	+2.0	+1.3	40 44 39.53	— 8 16.52	— 8	+ 51	—15	23.29	—9	29.6
Mar. 6	V 6	R	23.1143	21.7887	— 19	—3 6	—3.5	40 36 57.06	— 33.53	+ 12	—1.06	— 1	22.58	+ 3	32.3
	7		13.9377	29.1460	+139	—2.8	—1.9	40 42 47.97	— 6 24.55	— 3	— 72	—13	22.54	+ 3	
	8		19.0060	23.1660	+ 27	+1.2	+ .8	40 34 37.75	+ 1 45.16	+ 9	+ 31	+ 4	23.35	+ 3	
	9		13.4760	27.7803	+ 54	—2.2	—1.3	40 42 25.04	— 6 1.49	— 4	— 54	—10	22.87	+ 3	
	10		22.0450	18.4460	+ 4	+ .8	— .2	40 37 54.08	— 1 30.93	+ 4	+ 11	— 3	23.27	+3	
	VI 1		25.8230	17.6800	+ 83	+ .2	+ .9	40 32 56.49	+ 3 25.92	+ 13	+ 15	+ 6	22.75	+ 3	32.5
	2		17.8220	24.3147	+ 40	+1.5	+1.6	40 33 38.23	+ 2 44.12	+ 11	+ 46	+ 5	22.97	+ 3	
	3		13.0907	29.4900	+125	—1.7	—1.3	40 43 18.15	— 6 54.60	— 5	— 46	—13	22.91	+3	32.6
	4		16.3383	22.3380	— 23	+1.9	+ .6	40 33 51.34	+ 2 31.50	+ 10	+ 40	+ 4	23.38	+2	32.4
	5		18.9083	24.6263	+ 61	—2.5	—2.2	40 38 48.09	— 2 24.60	+ 3	— 71	— 5	22.76	2	32.4
	6		31.8817[iv]	10.8793[ii]	+ 8	+ .9	+1.2	40 27 30.77	+ 8 50.58	+ 1.05	+ 31	+ 19	22.90	+2	
	7		18.2547	20.9893	— 6	— .4	— .2	40 37 32.12	— 1 9.07	+ 4	— 9	— 2	22.98	+ 2	
	8		29.3043	12.7720	+101	+ .6	— .7	40 43 21.23	— 6 57.90	— 5	+ 1	—13	23.16	+ 2	31.9
	9		9.7057[ii]	29.3433[iv]	0	—1.0	—2.3	40 28 5.86	+ 8 16.09	+1.02	— 46	+15	22.66	+1	32.2
	10		17.3737	23.0897	+ 8	+ .9	0	40 33 58.55	+ 2 24.41	+ 10	+ 15	+ 4	23.25	+ 1	31.6
	11		27.5433	15.0923	+ 98	0	0	40 31 7.82	+ 5 14.79	+ 16	0	+10	22.87	+1	
Mar. 7	12		10.2643	31.5980	+117	—1.1	—2.3	40 27 23.91	+ 8 59.23	+ 23	— 48	+18	23.07	0	30.9
	V 6	D	17.8960	19.3007	— 12	+2.3	+3.8	40 36 57.03	— 35.45	+ 12	+ 88	— 1	22.57	+ 3	36.5
	7		29.1957	13.9573	+ 142	+1.7	+1.2	40 42 47.95	— 6 25.31	— 3	+ 44	—13	22.92	+3	36.4
	8		21.7667	17.6493	— 8	+4.0	+3.2	40 34 37.74	+ 1 43.99	+ 10	+1.09	+ 4	22.96	+ 3	
	9		27.6000	13.2557	+ 37	+2.7	+2.0	40 42 25.04	— 6 2.45	— 4	+ 72	—10	23.17	+ 3	
	10		20.8227	24.4527	+ 55	+3.3	+1.5	40 37 54.08	— 1 31.84	+ 4	+ 76	— 3	23.01	+ 3	
	VI 1		15.6580	23.8153	— 13	+1.3	— .1	40 32 56.50	+ 3 26 03	+ 13	+ 20	+ 6	22.92	+ 3	35.8
	2		23.0273	16.5187	— 10	+ .1	— .6	40 33 38.25	+ 2 44.39	+ 11	— 6	+ 5	22.74	+ 3	
	3		27.1980	10.7780	— 98	—1.7	—1.7	40 43 18.17	— 6 54.55	— 5	— 51	—13	22.93	+3	35.9
	4		23.5397	17.5623	+ 19	— .1	—1.1	40 33 51.38	+ 2 31.05	+ 10	— 15	+ 4	22.42	+2	
	5		22.8730	17.1453	0	—2.0	— .9	40 38 48.13	— 2 24.69	+ 3	— 45	— 5	22.97	+ 2	
	6		9.6383[ii]	30.6507[iv]	+ 1	+ .1	0	40 27 30.81	+ 8 50.81	+1.05	+ 1	+19	22.87	+2	
	7		22.4750	19.7257	+ 20	+ .1	— .4	40 37 32.18	— 1 9.50	+ 4	— 3	— 2	22.67	+ 2	
	8		11.5623	28.1050	— 18	— .5	— .4	40 43 21.30	— 6 57.85	— 5	— 13	—13	23.14	+2	35.0
	9		30.8263[iv]	11.2267[ii]	+ 1	+2.3	+1.8	40 28 5.94	+ 8 15.11	+ 1.02	+ 62	+ 15	22.84	+ 1	34.6
	10		21.5293	15.7893	— 45	— .9	—1.3	40 33 58.69	+ 2 24.89	+ 10	— 32	+ 4	23.40	+1	
	11		12.9670	25.4763	— 57	—1.5	—1.8	40 31 7.91	+ 5 15.86	+ 16	— 48	+ 10	23.55	+ 1	
	12		30.4597	9.1467	— 24	+ .4	+ .5	40 27 24.01	+ 8 58.34	+ 23	+ 13	+ 18	22.89	+ 1	34.3

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
Mar. 7	IX 7	R	9.5637ii	33.0257iv	+ 25	— .2	— .4	° ′ ″ 40 46 17.09	— 9.52.78	— 92	— 8	—17	° ′ ″ 40 36 23.14	—8	28.4
	X 1		26.0383	13.8227	— 5	— .7	—1.1	40 41 31.87	— 5 8.59	— 3	— 26	— 9	22.90	—9	
	2		31.8617iv	11.4630ii	+ 4	—1.4	—1.0	40 27 46.86	+ 8 35.34	+1.04	— 37	+17	23.04	—9	28.2
Mar.	3		22.0240	19.0077	+ 9	—1.7	— .7	40 35 6.83	+ 1 16.22	+ 8	— 38	+ 2	22.77	—9	
13	V 8	R	19.3360	23.5513	+ 36	—3.8	—4.7	40 34 37.84	+ 1 46.57	+ 10	—1.25	+ 4	23.30	+3	41.7
	10		22.0520	18.4920	+ 6	—1.1	—1.7	40 37 54.26	— 1 29.94	+ 4	— 41	— 8	23.92	+3	
	VI 1		25.7337	17.5520	+ 78	—1.8	—3.0	40 32 56.72	+ 3 26.87	+ 13	— 69	+ 6	23.09	+3	
	2		18.3197	24.8280	+ 60	+ .6	+1.1	40 33 38.53	+ 2 44.56	+ 11	+ 24	+ 5	23.49	+3	
	3		14.2413	30.6213	+234	—2.4	—1.9	40 43 18.47	— 6 54.35	— 5	— 65	—13	23.29	+3	39.9
	4		17.6960	23.6983	+ 24	— .6	— .9	40 33 51.77	+ 2 31.69	+ 10	— 21	+ 4	23.39	+3	
	5		17.9867	23.7047	+ 29	—1.9	—2.4	40 38 48.54	— 2 24.52	+ 3	— 63	— 5	23.37	+3	
	6		32.2890iv	11.2560ii	+ 11	—1.6	—1.9	40 27 31.22	+ 8 51.34	+1.05	— 52	+19	23.28	+2	
	7		19.3573	22.0983	+ 13	—2.2	—2.6	40 37 32.69	— 1 9.27	+ 4	— 71	— 2	22.73	+2	39.2
	8		28.7650	12.2357	+ 49	—3.4	—3.4	40 43 21.84	— 6 57.66	— 5	—1.02	—13	22.98	+2	39.4
	9		11.6193ii	31.2543iv	— 2	—1.2	—2.1	40 28 6.51	+ 8 15.99	+1.02	— 47	+15	23.20	+2	
	10		17.2973	22.9643	+ 4	—1.0	— .7	40 33 59.33	+ 2 23.17	+ 10	— 26	+ 4	22.38	+2	38.6
	11		27.8617	15.4393	+120	—1.6	—1.3	40 31 8 53	+ 5 14.10	+ 16	— 44	+10	22.45	+1	38.4
	12		9.9917	31.3180	+ 84	—1.9	—2.6	40 27 24.67	+ 8 58.93	+ 23	— 66	+18	23 35	+1	
	IX 7	D	31.2107iv	7.7600ii	— 11	— .9	—1.2	40 46 17.47	— 9 52.38	— 92	— 31	—17	23.69	—8	34.6
	X 1		13 0340	25.2713	— 62	— .6	— .9	40 41 32.17	— 5 8.97	— 3	— 21	— 9	22.87	—8	33.9
	2		8.8367ii	29.2903iv	— 0	—2.0	—3.0	40 27 47.09	+ 8 36.69	+1.04	— 73	+17	24.26	—8	34.0
	3		19.6233	22.6280	+ 19	+ .5	— .2	40 35 7.05	+ 1 15.96	+ 8	+ 6	+ 2	23.17	—9	
	4		12.4800ii	28.0383iv	— 7	+1.0	+ .1	40 29 48.42	+ 6 33.01	+ 99	+ 18	+11	22.71	—9	
Mar.	5		28.9247iv	8.2390ii	— 6	—2.0	—3.1	40 45 8.10	— 8 42.56	— 85	— 74	—20	23.75	—8	34.1
16	VI 1	D	14.8447	23.0047	— 52	+1.2	+ .6	40 32 56.92	+ 3 26.02	+ 13	+ 28	+ 6	23.41	+3	28.0
	2		23.9423	17.4557	+ 26	0	+ .5	40 33 38.75	+ 2 43.94	+ 11	+ 6	+ 5	22.91	+3	
	3		29.1750	12.7430	+ 93	— .6	+ .1	40 43 18.71	— 6 55.35	— 5	— 8	—13	23.10	+3	28.3
	4		21.9350	15.9703	— 36	+2.2	+1.9	40 33 52.07	+ 2 30.60	+ 10	+ 62	+ 4	23.43	+3	
	6		10.0920ii	31.0797iv	+ 4	+ .9	+ .5	40 27 31.53	+ 8 50.22	+1.05	+ 22	+19	23.21	+2	27.7
	9		30.3523iv	10.7953ii	0	+2.5	+3.9	40 28 6.92	+ 8 14.06	+1.02	+ 93	+ 15	23.08	+2	27.7
Mar.	10		22.2570	16.6390	— 19	+2.7	+3.4	40 33 59.76	+ 2 21.88	+ 10	+ 90	+ 4	22.68	+2	27.6
17	X 2	R	30.7600iv	10.3993ii	0	+ .9	+1.2	40 27 47.38	+ 8 34.38	+1.04	+ 31	+17	23.28	—8	27.0
	3		21.9487	18.9827	+ 8	+1.8	+2.3	40 35 7.34	+ 1 14.95	+ 8	+ 60	+ 2	22.99	—8	
	4		26.5750iv	10.9973ii	+ 32	—2.2	—1.9	40 29 48.69	+ 6 33.62	+ 99	— 62	+11	22.79	—9	
	5		10.8650ii	31.6220iv	+ 5	0	+1.6	40 45 8.28	— 8 44.40	— 85	+ 20	—20	23.03	—7	
	6		18.8243	23.4907	+ 33	+ .9	0	40 34 25.43	+ 1 57.98	+ 10	+ 15	+ 4	23.70	—8	27.0
	7		26.6383	15.1783	+ 61	+ .4	+ .4	40 31 33.31	+ 4 49.67	+ 14	+ 12	+ 8	23.32	—9	
	8		10.0507	29.6780	— 15	0	+ .8	40 44 39.44	— 8 15.80	— 8	+ 10	—15	23.51	—9	
	9		12.8397	30.2703	+156	+1.4	+1.5	40 43 43.41	— 7 20.75	— 5	+ 43	—13	22.91	—9	
	10		32.5117iv	8.4960ii	+ 12	+ .3	0	40 46 31.13	—10 6.74	— 92	+ 5	—17	23.35	—9	26.4
Mar.	XI 1		29.8580	14.2937	+189	— .3	— .2	40 42 57.09	— 6 33.67	— 1	— 7	—14	23.20	—8	26.4
18	VI 1	D	14.9480	23.0873	— 47	+ .8	+2.0	40 32 56.97	+ 3 25.50	+ 13	+ 39	+ 6	23.05	+3	35.5
	2		23.1453	16.6783	— 3	+2.4	+1.4	40 33 38.83	+ 2 43.37	+ 11	+ 59	+ 5	22.95	+3	
	3		12.4300	28.8700	+ 63	— .5	+ .8	40 43 18.80	— 6 55.47	— 5	+ 2	—13	23.17	+3	
	4		16.9543	22.9070	— 3	+ .7	+ .8	40 33 52.20	+ 2 30.37	+ 10	+ 22	+ 4	22.93	+3	34.4
	5		17.5140	23.3120	+ 13	+ .9	+ .9	40 38 49.00	— 2 26.50	+ 3	+ 27	— 5	22.75	+3	
	6		29.0133iv	8.0480ii	— 9	+ .3	+ .4	40 27 31.68	+ 8 49.60	+1.05	+ 10	+19	22.62	+2	
	7		18.5097	21.2970	— 2	+ .1	+1.8	40 37 33.24	— 1 10.41	+ 4	+ 24	— 2	23.09	+3	
	8		30.0120	13.4353	+169	+ .4	+1.2	40 43 22.43	— 6 59.19	— 5	+ 22	—13	23.28	+2	32.5
	9		11.1673ii	30.7207iv	0	+1.6	+3.0	40 28 7.14	+ 8 13.96	+1.02	+ 66	+15	22.93	+2	
	10		17.1277	22.7583	— 2	+2.3	+2.6	40 34 0.01	+ 2 22.23	+ 10	+ 72	+ 4	23.10	+2	32.0
	11		26.5400	14.1423	+ 24	0	+ .4	40 31 9.22	+ 5 13.25	+ 16	+ 5	+10	22.78	+2	31.9
	12		10.1683	31.4440	+101	—2.0	—2.4	40 27 25.41	+ 8 57.72	+ 23	— 65	+18	22.89	+1	
	VII 1		32.3903	17.9533	+442	+1.3	+1.9	40 30 16.48	+ 6 5.82	+ 18	+ 46	+12	23.06	+1	
	2		16.7180	25.6680	+ 64	+ .4	+1.6	40 40 9.01	— 3 46.26	0	+ 27	— 7	22.95	+1	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
Mar.								° ′ ″					° ′ ″		
18	VII 3		22.1717	19.1213	+ 12	| .8	+| .9	40 35 5.53	|- 1 17.02	|- 8	|- 25	+ 2	40 36 22.90	+1	30.6
	5		29.6657	12.2910	| 100	+|1.4	+2.6	40 29 2.63	+ 7 19.17	+| 23	+| 57	| 13	22.73	0	
	6		28.7360	14.4277	|-134	|-1.5	|- .9	40 42 24.05	— 6 1.79	— 9	|- 37	—10	22.44	0	
	7		25.8000	13.9120	— 9	+2.3	| 2.1	40 41 21.64	|- 4 59.54	— 6	+| 66	— 8	22.62	0	29.2
	8		19.4183	21.7807	|- 8	— .1	0	40 37 22.56	— 59.70	| 3	— 1	— 2	22.86	—1	28.9
	9		26.8167	14.3087	|- 41	| 1.6	| 2.0	40 31 5.62	+ 5 16.08	+| 22	| 53	+12	22.57	—1	
	10		19.1637	20.0373	— 3	+1.7	| 2.3	40 36 44.45	— 22.06	|- 5	| 58	— 1	23.01	—1	28.9
	X 2	D	10.2887[ii]	30.6587[iv]	0	— .2	| 1.3	40 27 47.50	| 8 34.62	| 1.10	+| 13	+17	23.52	—8	26.3
	3		18.4167	21.4193	— 2	|- .4	|- .1	40 35 7.47	+| 1 15.85	| 9	| 8	|- 2	23.51	—8	
	4		12.5433[ii]	28.0977[iv]	— 9	+ .6	+| .4	40 29 48.81	|- 6 32.94	|-1.04	+| 15	| 11	23.05	—9	
	5		30.8693[iv]	10.1317[ii]	|- 1	0	0	40 45 8.37	— 8 43.83	— 92	0	—20	23.42	—7	
	6		21.3637	16.7063	— 27	— .8	— .8	40 34 25.52	| 1 57.60	| 12	— 24	+| 4	23.04	—8	25.9
	7		18.6780	30.0937	+|-296	+1.2	+| .5	40 31 33.39	|- 4 49.14	+| 18	|- 27	| 8	23.06	—9	25.6
	9		28.7780	11.3620	| 7	|- .2	| .2	40 43 43.46	— 7 20.00	— 11	+ 6	—13	23.28	—9	
	10		7.4307[ii]	31.4150[iv]	— 15	—1.1	—1.0	40 46 31.17	—10 5.89	—1.00	—1.21	—17	22.90	—9	24.4
Mar.	XI 1		13.3967	28.9520	| 107	— .7	—1.1	40 42 57.11	— 6 33.25	— 6	— 26	—14	23.40	—8	24.5
21	VI 1	D	12.7623	20.9617	—153	—1.0	—1.7	40 32 56.93	|- 3 26.73	+ 16	— 39	|- 6	23.49	| 3	44.4*a*
	2		23.5910	17.0833	+ 13	— .8	— .5	40 33 38.83	+|- 2 44.42	| 13	— 20	|- 5	23.23	|-3	
	3		27.0720	10.6097	—113	0	+| .8	40 43 18.80	— 6 55.55	— 10	-|- 10	—13	23.12	| 3	44.0
	4		23.0603	17.0923	+ 2	— .2	— .9	40 33 52.27	|- 2 30.75	|- 12	— 15	+| 4	23.03	| 3	44.0
Mar.	5		21.9853	16.2020	—| 31	| .7	| .3	40 38 49.08	— 2 26.01	+ 1	+| 16	— 5	23.19	| 3	43.4
27	VI 2	D	24.4967	17.9857	+ 49	— .9	—1.0	40 33 38.91	| 2 44.60	+ 13	— 27	| 4	23.41	-|-3	
	4		21.4170	15.4333	— 57	—1.3	—2.0	40 33 52.47	+|- 2 31.01	+| 12	— 46	+| 4	23.18	+3	40.2
	5		23.3303	17.5667	| 15	—1.9	—2.7	40 38 49.32	— 2 25.63	+|- 1	— 64	— 5	23.01	+3	
	6		9.7427[ii]	30.7300[iv]	— 3	—1.6	—1.7	40 27 32.01	| 8 50.16	-| 1.12	— 47	| 19	23.01	-|-3	
	7		21.7447	18.9753	+|- 6	—1.6	—2.4	40 37 33.72	— 1 9.97	|- 3	— 56	— 2	23.20	-|-3	
	8		11.2663	27.8787	— 42	—1.0	—2.2	40 43 22.96	— 6 59.54	— 10	— 44	—13	22.75	+3	38.6
	9		29.4730[iv]	9.9280[ii]	— 00	— .5	—1.1	40 28 7.75	|- 8 13.73	| 1.09	— 22	-| 15	22.50	-|-3	
	10		23.3143	17.6467	+|- 15	—3.2	—3.1	40 34 0.73	+| 2 23.21	|- 12	— 90	+|- 4	23.20	| 2	38.1
	11		13.9233	26.3200	|- 7	— .8	—1.0	40 31 9.94	| 5 13.17	| 20	— 25	|-10	23.16	| 2	38.2
	12		30.6153	9.4080	0	| .1	| 1.0	40 27 26.21	| 8 55.72	|- 30	-|- 14	-| 17	22.54	-|-2	
	VII 1		11.5383	26.0230	—105	— .6	— .8	40 30 17.29	| 6 5.63	+| 23	— 20	| 12	23.07	| 2	
	2		24.0440	15.0730	— 24	— .1	+| .1	40 40 9.69	— 3 46.55	— 3	0	— 7	23.04	| 2	37.9
	3		19.2937	22.3127	|- 14	|-1.3	| 1.5	40 35 6.53	+|- 1 16.29	+|- 9	+|- 40	+| 2	23.33	+2	37.5
	4		15.0590	24.0123	— 24	+|- .3	— .2	40 40 9.94	— 3 46.86	-|- 2	+| 2	— 8	23.04	-|-1	
	5		12.7343	30.1117	-| 145	—1.0	—1.6	40 29 3.79	+| 7 19.33	| 23	— 36	-|-13	23.12	+1	
	6		13.3923	27.7440	+ 49	+1.2	| 1.9	40 42 25.27	— 6 2.66	— 9	+| 43	—10	22.85	+1	
	7		13.0550	24.9710	— 70	|-1.7	+2.1	40 41 22.94	— 5 0.84	— 7	-| 54	— 8	22 49	+1	36.7
	8		22.1000	19.6830	| 12	+ .3	0	40 37 23.90	-- 1 1.08	-|- 2	+| 5	— 2	22.87	0	
	9		11.6907	24.2183	—151	— .4	— .3	40 31 6.81	|- 5 16.08	+| 22	— 10	+|-12	23.13	0	36.2
	10		22.8017	21.8937	| 15	+|- .7	|- .5	40 36 45.81	— 22.97	|- 5	| 18	— 1	23.06	0	35.6
	X 6	R	18.1933	22.8093	|- 14	0	+|- .1	40 34 26.28	|- 1 56.64	+| 12	|- 2	+ 4	23.10	—8	32.2
	7		26.6067	15.1850	-|- 61	— .2	— .3	40 31 34.11	+| 4 48.69	-|- 18	— 7	+ 9	23.00	—9	31.7
	8		11.4257	31.0917	+| 145	+| .2	+1.3	40 44 40.16	— 8 17.17	— 15	-| 20	—15	22.89	—8	
	9		11.8483	29.3157	| 59	+| .9	+|-1.5	40 43 44.01	— 7 21.42	— 11	+| 34	—13	22.72	—9	
	10		33.1717[iv]	9.1343[ii]	| 28	| 1.6	-| 1.3	40 46 31.66	—10 7.31	—1.00	+| 42	—18	23.59	—9	31.5
	XI 1		29.7083	14.1197	+|-173	— .6	—1.3	40 42 57.43	— 6 34.24	— 6	— 26	—14	22.73	—8	30.8*b*
Mar.	2		10.6447[ii]	34.7193[iv]	|- 61	+|-2.8	-|-2.5	40 46 31.36	—10 8.34	— 95	| 76	—23	22.60	—8	30.6
28	VI 2	R	17.2440	23.7123	17	+1.5	| 1.4	40 33 38.96	| 2 43.45	+ 13	+|- 42	+ 4	23.00	+3	34.4*a*
	3		12.4360	28.8963	| 65	+|- .7	-| .9	40 43 18.97	— 6 55.99	— 10	+|- 22	—13	22.97	|-3	*a*
	4		17.6047	23.5400	| 20	| .6	| .8	40 33 52.54	+ 2 29.98	+ 12	|- 20	-| 4	22.88	+3	33.6
	5		17.5010	23.3093	+|- 13	| 1.1	+|- .9	49 38 49.39	— 2 26.76	|- 1	+| 29	— 5	22.88	-|-3	
	6		30.5127[iv]	9.5893[ii]	0	+3.0	| 3.6	40 27 32.09	+|- 8 48.57	+|-1.12	+| 93	| 19	22.90	+3	
	7		18.3843	21.2270	— 4	+3.0	-| 3.1	40 37 33.80	— 1 11.81	+ 3	-|- 86	— 2	22.86	| 3	
	8		28.7493	12.1027	+|- 41	+| 2.3	+|-2.6	40 43 23.06	— 7 0.63	— 11	+ 70	—13	22.89	+3	32.2

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
Mar.								° ′ ″					° ′ ″		
28	VI 9		10.9057[II]	30.4727[IV]	0	—2.1	—4.2	40 28 7.86	+ 8 14.31	+1.09	— 86	+15	40 36 22.55	+3	
	11		26.9287	14.5750	+ 55	— .4	+ .8	40 31 10.07	+ 5 12.22	+ 20	+ 4	+10	22.63	+2	31.7
	12		10.4860	31.6947	+136	— .2	— .2	40 27 26.35	+ 8 56.12	+ 30	— 6	+17	22.88	+2	31.0
	VII 1		29.1533	14.7393	+165	+1.4	+2.0	40 30 17.42	+ 6 4.54	+ 23	+ 48	+12	22.79	+2	31.6
	2		15.4440	24.4530	— 3	+1.2	+1.8	40 40 9.84	— 3 47.58	— 3	+ 42	— 7	22.58	+2	
	3		22.0983	19.1050	+ 10	+1.8	+1.7	40 35 6.68	+ 1 15.65	+ 9	+ 50	+ 2	22.94	+2	
	4		26.5877	17.5987	+111	+1.7	+1.9	40 40 10.08	— 3 47.36	+ 2	+ 51	— 8	23.17	+1	31.6
	5		28.4000	11.0507	— 28	+ .3	+1.5	40 29 3.96	+ 7 18.21	+ 23	+ 24	+13	22.77	+1	
	6		27.9433	13.5910	+ 66	+1.7	+2.1	40 42 25.45	— 6 2.73	— 9	+ 54	—10	23.07	+1	
	7		26.0813	14.2127	+ 9	—1.4	—1.2	40 41 23.11	— 4 59.85	— 6	— 38	— 8	22.74	+1	
	8		19.4710	21.9060	+ 9	+1.7	+2.3	40 37 24.09	— 1 1.54	+ 2	+ 56	— 2	23.11	0	29.6
	9		27.5290	15.0490	+ 95	—1.2	— .6	40 31 6.98	+ 5 15.51	+ 22	— 26	+12	22.57	0	
	10		19.6797	20.5950	0	—1.4	—1.4	40 36 45.99	— 23.12	+ 5	— 40	— 1	22.51	0	29.9
	X 6	D	21.2377	16.6340	— 31	+ .7	+ .8	40 34 26 35	+ 1 56.23	+ 12	+ 21	+ 4	22.95	—8	25.4
	7		14.6687	26.0840	+ 27	+1.0	+ .7	40 31 34.20	+ 4 48.46	+ 18	+ 25	+ 9	23.18	—9	
	8		29.2343	9.5520	— 71	— .7	+ .1	40 44 40.23	— 8 17.06	— 15	— 10	—15	22.77	—8	
	9		27.9220	10.4637	— 85	+1.4	+1.1	40 43 44.09	— 7 20.84	— 11	+ 36	—13	23.37	—9	
	10		7.7790[II]	31.8500[IV]	— 4	+ .1	+ .5	40 46 31.69	—10 8.11	—1.00	+ 8	—18	22.48	—9	24.8
	XI 1		10.8140	26.4750	—126	+2 8	+2.4	40 42 57.45	— 6 35.33	— 6	+ 74	—10	22.70	—8	24.5
	2		30.4447[IV]	6.4053[II]	— 38	+1.5	— .4	40 46 31.38	—10 7.22	— 95	+ 19	—11	23.29	—8	
Mar.	3		32.5147[IV]	6.8353[II]	— 12	—3.0	—3.2	40 25 33.34	+10 48.72	+1.12	— 88	+18	22.48	—9	24.4*a*
29	VI 2	D	23.6147	17.1027	+ 13	—1.0	— .3	40 33 39.00	+ 2 44.53	+ 13	— 20	+ 4	23.50	+3	38.9*a*
	3		28.3053	11.8753	+ 9	— .6	—1.6	40 43 19.02	— 6 55.07	— 10	— 30	—13	23.42	+3	*a*
	4		23.6710	17.6970	+ 24	—2.0	—2.8	40 33 52.61	+ 2 30.97	+ 12	— 68	+ 4	23.06	+3	37.9
	5		21.3797	15.5850	— 52	+ .5	— .1	40 38 49.46	— 2 26.25	+ 1	+ 6	— 5	23.23	+3	37.5
	6		8.6937[II]	29.6623[IV]	— 4	—1.0	—1.2	40 27 32.17	+ 8 49.69	+1.12	— 31	+19	22.86	+3	37.1
	7		21.3360	18.5330	— 2	—1.0	— .3	40 37 33.89	— 1 10.80	+ 3	— 20	— 2	22.90	+3	36.7
	8		11.6307	28.2380	— 7	—2.7	—2.7	40 43 23.16	— 6 59.51	— 10	— 77	—13	22.65	+3	36.2
	9		29.7680[IV]	10.2157[II]	0	+ .1	— .3	40 27 7.97	+ 8 13.92	+1.09	— 2	+15	23.11	+3	36.1
	10		21.5077	15.8360	— 44	—3.0	—3.6	40 34 0.97	+ 2 23.15	+ 12	— 93	+ 4	23.35	+3	35.6
	11		13.5190	25.9303	— 22	—1.7	—3.5	40 31 10.19	+ 5 13.47	+ 20	— 71	+10	23.25	+2	
	12		30.5833	9.3620	— 4	— .7	—1.5	40 27 26.49	+ 8 56.07	+ 30	— 30	+17	22.73	+2	34.4
	VII 1		13.6290	28.0943	+ 73	— .7	—1.3	40 30 17.57	+ 6 5.59	+ 23	— 28	+12	23.23	+2	
	2		24.4860	15.5193	+ 1	—1.1	—2.6	40 40 10.48	— 3 46.52	— 3	— 50	— 7	23.36	+2	
	3		18.1113	21.1547	— 7	—1.5	—1.4	40 35 6.85	+ 1 16.87	+ 9	— 42	+ 2	23.41	+2	
	4		14.8383	23.8090	— 36	—2.9	—3.4	40 40 10.22	— 3 46.53	+ 2	— 89	— 8	22.74	+1	33.9
	5		11.0563	28.4340	— 25	+ .1	— .7	40 29 4.14	+ 7 18.92	+ 23	— 8	+13	23.34	+1	
	6		12.3207	26.6853	— 42	+ .2	+ .2	40 42 25.64	— 6 2.76	— 9	+ 6	—10	22.75	+1	
	7		14.2857	26.1757	+ 16	+ .7	+ .4	40 41 23.31	— 5 0.40	— 7	+ 16	— 8	22.92	+1	32.7
	8		21.6757	19.2763	+ 7	—1.7	—2.3	40 37 24.29	— 1 0.63	+ 2	— 56	— 2	23.10	+1	
	9		13.1687	25.6993	— 42	—1.9	—2.2	40 31 7.16	+ 5 16.43	+ 22	— 58	+12	23.35	0	32.0
	10		20.9560	20.0527	+ 3	—2.2	—2.8	40 36 46.21	— 22.82	+ 5	— 70	— 1	22.73	0	32.0
	X 6	R	18.9717	23.6403	+ 36	—4.8	—5.1	40 34 26.45	+ 1 58.03	+ 12	—1.41	+ 4	23.23	—8	28.4
	7		25.0830	13.6510	— 42	— .3	— .5	40 31 33.46	+ 4 48.69	+ 18	— 12	+ 9	22.30	—8	28.4
	9		11.7090	29.1400	+ 42	— .8	0	40 43 44.17	— 7 20.46	— 11	— 12	—13	23.35	—8	
	10		32.4283[IV]	8.3993[II]	+ 10	— .5	— .8	40 46 31.75	—10 7.06	—1.00	— 18	—18	23 33	—9	28.0
	XI 1		29.6497	14.0797	+171	— .4	+ .3	40 42 57.49	— 6 33.78	— 6	— 1	—14	23.50	—8	
	2		9.8973[II]	33.9103[IV]	+ 47	—1.0	—1.0	40 46 31.39	—10 6.76	— 95	— 28	—23	23.17	—8	28.0
Apr.	3		6.8993[II]	32.5763[IV]	— 8	—1.3	—1.8	40 26 33.35	+10 48.65	+1.14	— 43	+18	22.89	—9	27.9
2	VI 6	R	31.9250[IV]	10.9870[II]	+ 8	+1.2	+1.6	40 27 32.33	+ 8 48.91	+1.12	+ 39	+19	22.94	+3	49.8
	7		19.1510	21.9447	+ 9	— .9	—1.4	40 37 34.12	— 1 10.59	+ 3	— 32	— 2	23.22	+3	48.3
	8		28.7077	12.0790	+ 38	+1.2	+ .4	40 43 23.43	— 7 0.13	— 11	+ 24	—13	23.30	+3	46.7
	9		10.6883[II]	30.1990[IV]	0	0	— .2	40 28 8.29	+ 8 12.83	+1.09	— 2	+15	22.34	+3	45.8
	10		17.7333	23.2953	+ 16	+3.7	+3.8	40 34 1.35	+ 2 20.53	+ 12	+1.07	+ 4	23.11	+3	45.0
	11		26.6340	14.3080	+ 32	+ .4	+1.4	40 30 10.58	+ 5 11.43	+ 20	+ 24	+10	22.55	+3	44.9

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Apr. 2	VI 12	R	10.3947	31.5660	+123	+1.1	+1.6	40 27 26.92	+ 8 55.09	+ 30	+ 38	+ 17	40 36 22.86	+2	43.9
	VII 1		28.9157	14.4910	+ 145	— .3	— .3	40 30 18.02	+ 6 4.73	+ 23	— 9	+12	23.01	+2	
	2		16.6147	25.6417	+ 59	+ .8	+1.2	40 40 10.53	— 3 48.17	— 4	+ 28	— 7	22.53	+2	
	3		21.8100	18.8107	+ 6	—1.5	— .8	40 35 7.41	+ 1 15.78	+ 9	— 34	+ 2	22.96	+2	43.7
	4		25.7553	16.7373	+ 66	+1.4	+1.3	40 40 10.75	— 3 47.96	+ 2	+ 39	— 8	23.12	+2	
	5		29.0607	11.7183	+ 38	— .8	— .5	40 29 4.79	+ 7 18.16	+ 23	— 19	+ 13	23.12	+2	
	6		27.2020	12.7930	0	+ 1.6	+2.5	40 42 26.33	— 6 3.97	— 9	+ 57	—10	22.74	+2	42.6
	7		25.7743	13.8313	— 15	+1.9	+1.5	40 41 24.05	— 5 1.89	— 7	+ 49	— 8	22.50	+1	42.4
	8		20.9037	23.3543	+ 32	— .6	+ .5	40 37 25.06	— 1 1.98	+ 2	— 3	— 2	23.05	+1	
	9		26.9260	14.4497	+ 49	— .2	— .6	40 31 7.89	+ 5 15.27	+ 22	— 10	+ 12	23.40	+1	
Apr. 4	10		20.3080	21.2257	+ 3	—2.4	—2.1	40 36 47.01	— 23.19	+ 5	— 64	— 1	23.22	0	41.0
	VI 10	D	22.5890	16.9793	— 6	+ .3	+ .4	40 34 1.44	+ 2 21.66	+ 12	+ 10	+ 4	23.36	+3	65.0
	11		13.1933	25.5533	— 45	+2.3	+ .2	40 31 10.68	+ 5 12.14	+ 20	+ 39	+10	23.51	+3	64.2
	12		30.9990	9.8063	+ 50	— .8	—1.4	40 27 27.06	+ 8 55.38	+ 30	— 30	+17	22.61	+2	64.2
	VII 3		16.9900	19.9953	— 27	+1.0	+ .2	40 35 7.60	+ 1 15.83	+ 9	+ 18	+ 2	23.72	+2	62.5
	4		13.2367	22.2720	—119	—1.0	— .5	40 40 10.91	— 3 47.90	+ 2	— 22	— 8	22.73	+ 2	
	5		9.9990	27.3330	—135	+ .3	+ .1	40 29 5.01	+ 7 17.45	+ 23	+ 6	+ 13	22.88	+2	61.6
	X 7	D	12.8403	24.2350	— 98	—1.2	—2.2	40 31 35.27	+ 4 47.58	+ 18	— 46	+ 9	22.66	—8	47.6
	8		28.3890	8.6793	—169	—1.9	—2.6	40 44 41.22	— 8 17.43	— 15	— 63	—15	22.86	—8	47.3
	9		28.6300	11 1850	— 10	—1.8	—2.7	40 43 45.01	— 7 20.63	— 11	— 62	—13	23.52	—8	
	10		7.0413ii	31.1433iv	— 23	+1.4	+1.0	40 46 32.52	—10 8.75	—1.00	+ 35	—18	22.94	—9	46.2
	XI 1		13.4543	29.1017	+117	+1.2	+1.0	40 42 58.13	— 6 35.54	— 6	+ 32	—14	22.71	—8	
	2		31.6647iv	7.5887ii	— 9	0	+ .2	40 46 31.91	—10 8.13	— 95	+ 2	—23	22.62	—8	
	3		31.6863iv	6.0790ii	— 36	+ .4	+1.2	40 25 33.87	+10 46.75	+1.14	+ 22	+ 18	22.16	—9	45.1
	4		31.8627iv	6.4097ii	— 28	— .3	0	40 25 38.94	+10 42.87	+1.14	— 5	+19	23.09	—9	
Apr. 16	5		33.8527iv	0.5550ii	—220	—1.7	— .8	40 22 20.84	+14 0 54	+1.23	— 37	+26	22.50	—9	40.6
	VII 1	D	11.6150	26.0217	—103	+ .6	— .2	40 30 19.10	+ 6 3.64	+ 28	+ 7	+ 12	23.21	+ 3	48.6
	2		23.8663	14.8340	— 36	—1.8	—1.1	40 40 11.95	— 3 48.05	— 7	— 42	— 7	23.34	+ 3	
	3		17.9687	20.9293	— 9	— .8	— .6	40 35 8.82	+ 1 14.76	+ 10	— 20	+ 2	23.50	+3	48.4
	4		14.3690	23.4060	— 58	—2.4	—3.2	40 40 12.06	— 3 48.12	— 2	— 78	— 8	23.06	+3	
	5		11.0513	28.3307	— 30	+ .3	0	40 29 6.50	+ 7 16.39	+ 29	+ 5	+13	23.36	+ 3	
	6		13.2153	27.6683	+ 38	—1.0	—2.1	40 42 28.19	— 6 5.16	— 14	— 42	—10	22.37	+3	48.2
	7		13.8350	25.8057	— 14	—1.8	—1.0	40 41 26.11	— 5 2.33	— 11	— 41	— 8	23.18	+ 3	
	8		20.8513	18.3187	— 6	0	— .9	40 37 27.22	— 1 3.96	+ 2	— 12	— 2	23.14	+2	48.1
	9		13.0357	25.4433	— 55	+ .7	0	40 31 9.88	+ 5 13.26	+ 26	+ 11	+ 12	23.63	+ 2	48.3
	10		19.5830	18.5403	— 5	0	—1.2	40 36 49.31	— 26.33	+ 5	— 15	— 1	22.87	+2	
Apr. 17	VIII 2		25.5227	13.2937	— 43	+ .5	+ .8	40 31 13.40	+ 5 8.78	+ 27	+ 18	+11	22.74	+1	47.8
	X 7	R	24.6957	13.4067	— 63	+ .6	+ .3	40 31 37.55	+ 4 45.00	+ 22	+ 14	+ 9	23.00	—7	43.0
	8		9.5677	29.3697	— 63	+1.0	+ .4	40 44 43.38	— 8 20.04	— 21	+ 21	—15	23.19	—7	
	9		11.4977	29.0417	+ 27	—2.8	— .5	40 43 47.06	— 7 23.23	— 17	— 51	—13	23.02	—7	43.1
	10		32.5667iv	8.4353ii	+ 13	— .4	—1.7	40 46 34.48	—10 9.59	—1.08	— 28	—18	23.35	—8	
	XI 1		29.8470	14.2003	+186	— .7	—2.1	40 42 59.74	— 6 35.71	— 12	— 38	—14	23.39	—7	43.2
	2		9.8020ii	33.9060iv	+ 44	+1.0	+ .3	40 46 33.33	—10 8.98	—1.03	+ 20	—23	23 29	- 7	42.6
	3		6.0847ii	31.6813iv	— 37	— .2	— .7	40 25 35.38	+ 10 46.48	+1.23	— 12	+18	23.15	—8	
	4		7.4980ii	32.9333iv	+ 5	—1.5	—3 3	40 25 40.37	+10 42.51	+ 1.22	— 66	+ 19	23.63	—8	
	5		0.9127ii	34.2063iv	—191	—1.4	—4.0	10 22 22.13	+ 14 0.51	+1.34	— 73	+ 26	23.51	—8	
	6		27.0400	14.9113	+ 70	—2.1	—1.5	40 31 16.52	+ 5 6.54	+ 24	— 52	+10	22.88	—8	
Apr. 18	7		19.2760	22.2503	+ 14	—1.2	—2.6	40 37 38.73	— 1 15.17	+ 2	— 52	— 2	23.04	—9	42.1
	X 7	D	14.2883	25.5953	— 4	—3.5	—4.8	40 31 37.79	+ 4 45 61	+ 22	—1.16	+ 9	22.55	—7	43.2
	8		30.0163	10.2443	+ 10	—1.0	—1.6	40 44 43.60	— 8 19.47	— 21	— 36	—15	23.41	—7	
	9		27.8867	10.3497	— 91	—3 0	—3.8	40 43 47.28	— 7 22.76	— 17	— 96	—13	23.26	—7	43.2
	10		6.7390ii	30 9000iv	— 29	— .4	0	40 46 34.70	—10 10.24	—1.09	— 6	—18	23.13	—8	
	XI 1		10.8250	26.5433	—123	+ .3	+ .4	40 42 59.93	— 6 36.74	— 12	+ 10	—14	23.03	—7	42.8
	2		30.0270iv	5.9187ii	— 50	+1.6	+ .1	40 46 33.52	—10 8.85	—1.03	+ 27	—23	23.68	—7	42.7
	3		32.1607iv	6.5737ii	— 21	—1.5	—1.6	40 25 35.58	+10 46.28	+1.23	— 44	+18	22.83	—8	42.3

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
Apr.								° ′ ″					° ′ ″		
18	XI 4	D	32.4740iv	7.0843ii	— 7	— .2	— .1	40 25 40.56	+10 41.34	+1.22	— 5	+19	40 36 23.26	—8	41.9
	5		33.7367iv	0.4973ii	—227	+1.0	+1.0	40 22 22.30	+13 59.06	+1.33	+ 28	+26	23.23	—8	41.5
Apr.	6		13.4480	25.5883	— 34	+1.0	+ .2	40 31 16.69	+ 5 6.58	+ 24	+ 18	+10	23.79	—8	41.2
23	XI 2	R	9.1380ii	33.2663iv	+ 30	+1.4	— .7	40 46 34.24	—10 9.57	—1.03	+ 14	—23	23.55	—7	40.0
	3		7.3767ii	32.9147iv	+ 4	+1.1	+ .7	40 25 36.39	+10 45.11	+1.22	+ 26	+18	23.16	—8	
	4		7.2683ii	32.6493iv	— 2	— .4	—1.1	40 25 41.34	+10 41.13	+1.22	— 20	+19	23.68	—8	
	5		1.8883ii	35.0980iv	—117	+ .5	+ .5	40 22 23.04	+13 58.60	+1.34	+ 14	+26	23.38	—8	41.0
	6		26.7877	14.6753	+ 54	—3.8	—2.7	40 31 17.39	+ 5 6.10	+ 24	— 94	+10	22.89	—8	
Apr.	7		18.0780	21.1077	— 7	—1.4	— .7	40 37 39.60	— 1 16.51	+ 2	— 32	— 2	22.77	—8	40.4
24	VII 3	R	21.1083	18.1940	— 6	+ .8	+ .9	40 35 9.26	+ 1 13.60	+ 10	+ 24	+ 2	23.22	+3	51.4
	4		24.2553	15.1580	— 15	+1.0	+1.3	40 40 12.43	— 3 49.75	— 2	+ 32	— 8	22.90	+3	50.6
	5		26.8700	9.6177	—179	— .4	— .7	40 29 7.11	+ 7 15.33	+ 29	— 16	+13	22.70	+4	
	6		27.5333	13.0393	+ 25	+1.4	+1.4	40 42 28.89	— 6 6.17	— 14	+ 40	—10	22.88	+3	49.8
	7		25.3900	13.3610	— 45	0	— .3	40 41 26.92	— 5 3.73	— 11	— 4	— 8	22.96	+3	49.6
	8		18.7850	21.3710	+ 2	— .4	—1.2	40 37 28.09	— 1 5.33	+ 1	— 22	— 2	22.53	+3	
	9		27.0090	14.6690	+ 61	0	— .7	40 31 10.69	+ 5 11.85	+ 26	— 9	+12	22.83	+3	
	10		20.2883	21.3737	+ 5	— .1	— .2	40 36 50.29	— 27.43	+ 5	— 4	— 1	22.86	+3	
	VIII 1		22.6843	19.4083	+ 20	+1.3	+ .2	40 37 45.47	— 1 22.80	+ 1	+ 23	— 2	22.89	+2	48.8
	2		15.0950	27.2827	+ 87	+ .8	— .3	40 31 14.37	+ 5 8.07	+ 27	+ 8	+11	22.90	+2	48.4
	3		14.5170	26.8457	+ 49	—1.0	— .4	40 41 34.90	— 5 11.53	— 11	— 21	— 9	22.96	+2	*a*
	4		14.5590	22.9180	— 63	+ .7	+ .3	40 32 51.67	+ 3 30.98	+ 17	+ 15	+ 6	23.03	+2	47.6
	5		31.6150iv	11.8770ii	— 4	—2.0	—1.8	40 28 3.52	+ 8 18.56	+1.16	— 54	+17	22.87	+1	
	6		19.6313	22.6663	+ 20	—1.7	— .6	40 37 39.94	— 1 16.71	+ 3	— 34	— 3	22.89	+1	
	7		11.0533ii	26.9970iv	+ 23	+ .6	— .2	40 29 38.64	+ 6 42.78	+1.09	+ 7	+11	22.69	+1	46.8
	8		21.1203	20.3557	+ 3	— .9	— .6	40 36 3.10	+ 19.32	+ 11	— 22	+ 1	22.32	+1	
	9		27.9647	14.1697	+ 88	—2.3	—2.0	40 30 34.15	+ 5 48.67	+ 27	— 62	+11	22.58	0	
	10		5.4050ii	33.1010iv	— 35	+2.2	+1.1	40 48 2.84	—11 39.48	—1.11	+ 49	—24	22 50	0	46.4
Apr.	11		28.6130	13.2637	+ 86	+1.0	+ .2	40 42 50.97	— 6 27.93	— 16	+ 18	—11	22.95	0	46.0
25	VII 6	D	12.2833	26.7953	— 39	+1.0	+ .5	40 42 29.02	— 6 6.46	— 14	+ 22	—10	22.54	+4	48.3
	7		13.4590	25.5140	— 37	+1.7	+2.2	40 41 27.06	— 5 4.40	— 11	+ 54	— 8	23.01	+3	48.2
	XI 2	D	30.4190iv	6.2177ii	— 42	+1.8	+2.2	40 46 34.50	—10 11.24	—1.04	+ 56	—23	22.55	—6	41.0
	3		32.4163iv	6.8907ii	— 11	—2.0	—1.2	40 25 36.69	+10 44.77	+1.22	— 47	+18	22.39	—8	40.6
	4		31.4093iv	6.0507ii	— 40	+ .2	— .2	40 25 41.63	+10 40.48	+1.22	0	+19	23.52	—8	
	5		34.4307iv	1.2147ii	—170	—2.9	—2.2	40 22 23.31	+13 58.64	+1.34	— 74	+26	22.81	—8	39.6
	6		12.6103	24.6767	— 97	+ .1	0	40 31 17.64	+ 5 4.56	+ 24	+ 2	+10	22.56	—8	
	7		22.7733	19.7330	+ 23	— .5	— .7	40 37 39.84	— 1 16.86	+ 2	— 17	— 2	22.81	—8	
	8		20.2313	21.1753	+ 3	+ .3	+ .4	40 36 46.37	— 23.85	+ 5	+ 10	— 1	22.66	—8	
	I 1		23.8343	16.5357	+ 6	+1.2	+ .9	40 33 17.38	+ 3 4.39	+ 16	+ 30	+ 5	22.28	—8	38.2*a*
Apr.	2		25.8817	12.8440	— 50	— .1	+ .3	40 41 52.33	— 5 29.21	— 12	+ 2	—10	22.92	—8	38.0
28	VII 4	D	14.7163	23.8650	— 39	+3.2	+4.2	40 40 12.77	— 3 50.97	— 2	+1.04	— 9	22.73	+3	61.1
	5		13.2770	30.4750	+192	+ .4	+ .2	40 29 7.56	+ 7 14.86	+ 29	+ 9	+12	22.92	+4	60.4
	6		12.0063	26.5483	— 62	+1.7	+1.8	40 42 29.40	— 6 7.14	— 14	+ 50	—10	22.52	+4	
	7		13.4487	25.5310	— 36	+1.6	+ .9	40 41 27.48	— 5 5.07	— 11	+ 37	— 8	22.59	+3	59.9
	8		20.9240	18.2960	— 6	+1.9	+1.4	40 37 28.69	— 1 6.36	+ 2	+ 48	— 2	22.81	+4	59.4
	9		14.7930	27.1147	+ 69	+ .3	— .4	40 31 11.26	+ 5 11.39	+ 26	0	+12	23.03	+3	
	10		19.8907	18.7520	— 4	+2.5	+1.4	40 36 50.95	— 28.75	+ 4	+ 58	— 1	22.81	+3	
	VIII 1		17.3537	20.6773	— 20	+ .7	+ .8	40 37 46.17	— 1 23.89	+ 1	+ 21	— 2	22.48	+3	59.0
	2		25.5067	13.3463	— 41	+ .6	+1.0	40 31 15.04	+ 5 7.03	+ 27	+ 22	+11	22.67	+2	
	4		24.5570	16.2133	+ 19	—2.1	—2.3	40 32 52.48	+ 3 30.79	+ 17	— 62	+ 6	22.88	+2	58.1
	5		8.6390ii	28.3417iv	+ 3	+ .9	+ .4	40 28 4.33	+ 8 17.64	+1.16	+ 20	+17	23.50	+2	57.6
	6		21.3817	18.3140	— 3	+ .2	0	40 37 40.79	— 1 17.47	+ 3	+ 3	— 3	23.35	+2	
	7		27.3417iv	11.4307ii	+ 16	— .9	— .5	40 29 39.54	+ 6 41.91	+1.09	— 21	+11	22.44	+1	
	8		20.0020	20.7543	+ 3	—2.1	—2.0	40 36 3.90	+ 19.01	+ 11	— 58	+ 1	22.45	+1	
	9		13.2403	27.0080	+ 10	—1.0	— .4	40 30 35.02	+ 5 47.76	+ 27	— 21	+11	22.95	+1	56.0
	10		31.8307iv	4.1453ii	— 92	— .8	—1.3	40 48 3.73	—11 39.02	—1.11	— 29	—24	23.07	0	56.0

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Apr. 28	VIII 11	D	15.1057	30.4810	+255	—1.1	— .6	40 42 51.97	— 6 28.98	— 16	— 25	—11	40 36 22.47	0	54.5
May 6	VII 7	R	26.6633	14.5963	+ 44	— .9	—1.2	40 41 28.10	— 5 4.90	— 11	— 30	— 8	22.71	+4	54.4
	8		19.4343	22.0700	+ 11	+ .6	+ .7	40 37 29.39	— 1 6.60	+ 2	+ 18	— 2	22.97	+4	
	9		26.6337	14.3560	+ 35	+ .7	+ .7	40 31 11.93	+ 5 10.19	+ 26	+ 20	+12	22.70	+4	53.4
	10		19.1437	20.2967	— 2	—1.0	— .8	40 36 51.80	— 29.12	+ 4	— 26	— 1	22.45	+4	
	VIII 1		22.6197	19.3027	+ 19	— .2	— .7	40 37 47.12	— 1 23.83	+ 1	— 12	— 2	23.16	+4	
	2		14.9793	27.0983	+ 75	+ 1.3	+ 1.9	40 31 15.91	+ 5 6.29	+ 27	+ 44	+ 11	23.05	+3	52.5
	3		14.1710	26.5607	+ 26	+ .6	+ .7	40 41 36.87	— 5 13.01	— 11	+ 18	— 9	23.84	+3	
	4		16.1910	24.4807	+ 18	— .7	—1.2	40 32 53.68	+ 3 29.43	+ 17	— 26	+ 6	23.08	+3	
	5		32.0117iv	12.4197ii	— 6	+1.1	+1.3	40 28 5.52	+ 8 15.60	+1.16	+ 34	+17	22.79	+3	51.0
	6		19.0667	22.2127	+ 12	+ .4	+ .5	40 37 42.11	— 1 19.50	+ 3	+ 13	— 3	22.74	+2	
	7		13.7257ii	29.5737iv	— 39	+ 2.1	+1.8	40 29 40.98	+ 6 40.20	+1.09	+ 56	+11	22.94	+ 2	51.2
	8		22.4927	21.8160	+ 11	— .6	+ .2	40 36 5.16	+ 17.12	+ 11	— 7	+ 1	22.33	+2	
	9		27.1243	13.4247	+ 20	+ .2	— .7	40 30 36.45	+ 5 46.08	+ 27	— 6	+ 11	22.85	+2	50.5
	10		3.5663ii	31.3400iv	—117	+ .3	0	10 48 5.23	—11 41.22	—1.12	+ 5	—24	22.70	+1	50.2
	11		30.6917	15.2903	+ 273	—1.2	—3.0	40 42 53.70	— 6 29.78	— 16	— 57	—11	23.08	+ 1	49.0
	XI 2	R	8.1623ii	32.3707iv	+ 8	—1.8	—3.2	40 46 36.72	—10 11.52	—1.04	— 69	—23	23.24	—5	46.1
	3		5.6883ii	31.1457iv	— 51	—2.0	—2.4	40 25 39.16	+ 10 42.91	+ 1.22	— 62	+18	22.85	—7	
	4		8.1000ii	33.3773iv	+ 24	—1.7	—2.2	40 25 44.02	+10 38.55	+1.22	— 54	+ 19	23.44	—7	
	5		0.0577ii	33.1947iv	—261	+ .4	— .9	40 22 25.58	+ 13 56.36	+ 1.34	— 5	+ 26	23.49	—7	
	6		27.4563	15.4887	+105	—1.7	—1.6	40 31 19.82	+ 5 2.56	+ 24	— 47	+10	22.25	—7	
	7		19.3490	22.4720	+ 17	—1.1	—1.2	40 37 42.02	— 1 18.93	+ 2	— 32	— 2	22.77	—7	46.7
	8		20.3020	19.2727	0	—1.2	—1.4	40 36 48.45	— 26.00	+ 5	— 36	— 1	22.13	—8	
	I 1		15.7043	22.9810	— 28	—1.4	—2.1	40 33 19.40	+ 3 3.74	+ 16	— 49	+ 5	22.86	—8	45.9
	2		13.3083	26.4033	— 12	—1.7	—1.3	40 41 54.23	— 5 30.75	— 12	— 44	—10	22.82	—8	45.4
May 7	3		16.2307	22.6707	— 21	+ .3	+ .3	40 33 40.45	+ 2 42.62	+ 15	+ 9	+ 5	23.36	—8	45.4
	VII 7	D	12.8523	24.9393	— 79	— .4	— .1	40 41 28.19	— 5 5.09	— 11	— 8	— 8	22.83	+4	54.9
	8		19.9910	17.3357	— 23	+ 1.0	+1.2	40 37 29.48	— 1 7.01	+ 1	+ 31	— 2	22.77	+4	
	9		13.6450	25.9477	— 16	+1.0	— .6	40 31 12.02	+ 5 10.70	+ 26	+ 8	+ 12	23.18	+ 4	54.2
	10		20.7170	19.5907	0	+ .3	— .3	40 36 51.91	— 28.45	+ 4	+ 1	— 1	23.50	+4	
	VIII 1		16.7300	20.0703	— 33	— .6	—1.0	40 37 47.24	— 1 24.29	+ 1	— 22	— 2	22.72	+4	52.8
	2		23.7883	14.6403	+ 52	—1.3	—2.7	40 31 16.07	+ 5 6.97	+ 27	— 54	+11	22.88	+ 3	
	3		25.0870	12.6650	— 84	— .7	—1.6	40 41 37.01	— 5 13.54	— 11	— 31	— 9	22.96	+ 3	51.0
	4		24.6167	16.3467	+ 23	—1.1	—1.8	40 32 53.84	+ 3 28.95	+ 17	— 40	+ 6	22.62	+3	
	5		10.9957ii	30.6543iv	0	— .9	—1.7	40 28 5.65	+ 8 16.54	+1.16	— 36	+17	23.16	+3	
	6		22.4693	19.3447	+ 17	+ 1.3	+ .3	40 37 42.46	— 1 18.97	+ 3	+ 24	— 3	23.73	+3	
	7		28.7577iv	12.8847ii	— 21	—2.6	—1.7	40 29 41.15	+ 6 40.87	+1.09	— 63	+11	22.59	+ 2	51.4
	8		21.0170	21.7127	+ 6	+ .2	— .2	40 36 5.30	+ 17.59	+ 11	0	+ 1	23.01	+ 2	
	9		13.8473	27.5357	+ 57	+1.2	+ .3	40 30 36.61	+ 5 45.89	+ 27	+ 23	+ 11	23.11	+2	50.5
	10		32.8240iv	5.0833ii	— 47	+ .1	—1.8	40 48 5.40	—11 40.56	—1.12	— 21	—24	23.27	+2	50.1
	11		13.6893	29.1337	+128	— .6	—1.7	40 42 53.89	— 6 30.42	— 16	— 31	—11	22.89	+1	50.0
	XI 2	D	31.1057iv	6.8860ii	— 25	—2.5	—2.3	40 46 36.90	—10 11.72	—1.04	— 68	—23	23.23	—5	45.9
	3		32.0560iv	6.5897ii	— 22	—1.7	—1.8	40 25 39.36	+10 43.22	+ 1.22	— 50	+18	23.48	—7	
	4		31.7910iv	6.4773ii	— 27	—1.0	—2.0	40 25 44.21	+10 39 35	+1.22	— 41	+ 19	24.56	—7	
	5		36.4177iv	3.3087ii	— 11	—1.2	—1.6	40 22 25.76	+ 13 56.30	+1.34	— 39	+26	23.27	—7	
	6		13.8687	25.8550	— 10	+ .1	— .3	40 31 19.99	+ 5 2.75	+ 25	— 2	+10	23.07	—7	44.8
	7		21.8693	18.7373	+ 6	—1.3	—1.6	40 37 42.20	— 1 19.13	+ 2	— 40	— 2	22.67	—7	
	8		18.3010	19.3223	— 6	+ .2	+ .1	40 36 48.63	— 25.78	+ 5	+ 4	— 1	22.93	—8	44.6
	I 1		23.8763	16.6513	+ 11	+1.8	+ .9	40 33 19.57	+ 3 2.53	+ 16	+ 40	+ 5	22.71	—8	44.2
	2		24.6207	11.4913	—151	+ .6	+ .3	40 41 54.40	— 5 31.26	— 12	+ 14	—10	23.06	—8	
May 8	3		23.9500	17.5687	+ 29	+1.0	+1.6	40 33 40.60	+ 2 41.26	+ 15	+ 36	+ 5	22.42	—8	44.4
	1	R	21.5007	18.1507	— 3	— .1	0	40 37 47.37	— 1 24.60	0	— 2	— 2	22.73	+ 4	57.2
	VIII 2		14.2627	26.3700	+ 24	+ 2.1	0	40 31 16.18	+ 5 5.87	+ 30	+ 34	+ 11	22.80	+ 3	
	3		13.9670	26.3923	+ 14	— .5	— .1	40 41 37.16	— 5 13.87	— 15	— 10	— 9	22.95	+3	56.6
	4		16.0263	24.2957	+ 9	+ .1	— .4	40 32 54.00	+ 3 28.90	+ 19	— 4	+ 6	23.11	+3	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
May								° ′ ″					° ′ ″		
8	VIII 5	R	30.8213iv	11.1797ii	— 3	— .6	— .3	40 28 5.81	+ 8 16.10	+1.22	— 14	+17	40 36 23.16	+3	55.6
	6		18.2240	21.3900	— 4	— .3	— .6	40 37 42.44	— 1 19.95	+ 2	— 12	— 3	22.36	+3	
	7		12.7587ii	28.6027iv	— 17	+ .1	— .2	40 29 41.33	+ 6 40.14	+1.14	— 1	+11	22.71	+3	54.8
	8		22.9110	22.2217	+ 10	— .3	— .2	40 36 5.46	+ 17.44	+ 11	— 8	+ 1	22.94	+2	54.4
	9		28.5193	14.8567	+137	+ .1	+ .3	40 30 36.78	+ 5 45.44	+ 31	+ 6	+11	22.70	+2	
	10		5.4107ii	33.1877iv	— 32	— .2	0	40 48 5.58	—11 41.51	—1.20	— 3	—24	22.60	+2	53.6
	11		25.8373	10.3467	—176	— .4	—1.0	40 42 54.10	— 6 30.81	— 21	— 19	—11	22.78	+2	
	IX 1		29.1417	13.5093	+121	— .9	— .7	40 29 47.43	+ 6 35.15	+ 33	— 24	+12	22.79	+1	53.4a
	2		24.9870	17.2667	+ 51	+1.1	+ .8	40 39 38.22	— 3 15.13	— 7	+ 28	— 5	23.25	0	53.3
	3		17.3010	23.7163	+ 18	—1.3	—1.6	40 39 5.25	— 2 42.08	— 5	— 40	— 4	22.68	—0	
May															
9	4		19.2617	22.4957	+ 17	—1.0	— .3	40 37 44.01	— 1 21.72	+ 2	— 20	— 3	22.08	—1	52.8
	VIII 2	D	25.3437	13.2237	— 52	+ .2	— .3	40 31 16.32	+ 5 6.00	+ 30	— 1	+11	22.72	+3	59.6
	3		26.0080	13.5900	— 15	+ .1	—1.4	40 41 37.32	— 5 13.62	— 15	— 16	— 9	23.30	+4	
	4		24.7397	16.4883	+ 29	— .3	— .7	40 32 54.17	+ 3 28 49	+ 19	— 14	+ 6	22.77	+3	58.4
	5		7.9040ii	27.5380iv	+ 6	— .2	—1.2	40 28 5.98	+ 8 15.92	+1.22	— 18	+16	23.10	+3	
	6		22.5053	19.3507	+ 17	— .2	+ .2	40 37 42.62	— 1 19.71	+ 2	0	— 3	22.90	+3	57.6
	7		28.1393iv	12.3067ii	— 5	—1.3	—1.2	40 29 41.52	+ 6 39.88	+1.14	— 36	+11	22.29	+3	
	8		20.5777	21.2550	+ 3	— .6	— .4	40 36 5.62	+ 17.12	+ 11	— 24	+ 1	22.62	+ 2	
	9		12.6203	26.3097	— 44	—1.4	— .9	40 30 36.97	+ 5 45.66	+ 31	— 34	+11	22.71	+2	
	10		30.7657iv	2.9860ii	—142	— .5	—1.7	40 48 5.77	—11 41.30	—1.20	— 30	—23	22.74	+2	55.9
	11		13.4177	28.8810	+104	— .3	—1.0	40 42 54.32	— 6 30.83	— 21	— 18	—11	22.99	+2	54.6
	IX 2		16.3567	24.0453	+ 8	—3.5	—4.0	40 39 38.46	— 3 14.22	— 7	—1.06	— 5	23.06	0	
	3		24.0303	17.6230	+ 30	— .5	—2.2	40 39 5.49	— 2 41.91	— 5	— 36	— 4	23.13	0	53.1
	4		20.6673	19.3883	0	—2.1	—2.8	40 35 50.98	+ 32.31	+ 8	— 69	+ 1	22.69	0	
	5		21.1853	17.9780	— 8	—2.4	—2.6	40 37 44.24	— 1 20.99	+ 2	— 71	— 3	22.53	—1	52.8
	6		17.6613	19.0063	— 14	—1.8	—2.6	40 36 57.39	— 33.94	+ 7	— 62	— 1	22.89	—1	
May	7		31.3250iv	7.3903ii	— 16	— .6	— .7	40 46 28.92	—10 4.50	—1.15	— 18	—18	22.91	—1	51.9
10	VIII 1	R	22.9530	19.5987	+ 25	+ .7	+2.0	40 37 47.66	— 1 24.78	0	+ 36	— 3	23.21	+4	66.4
	2		14.9280	27.0510	+ 70	+ .3	+ .1	40 31 16.45	+ 5 6.36	+ 30	+ 6	+11	23.28	+3	65.9
	3		14.2453	26.6437	+ 33	—3.0	—3.1	40 41 37.49	— 5 13.22	— 15	— 86	— 9	23.17	+4	
	4		17.1353	25.4010	+ 60	— .6	—1.1	40 32 54.34	+ 3 28.92	+ 19	— 24	+ 6	23.27	+4	65.1
	5		30.3193iv	10.6867ii	0	—1.5	—1.1	40 28 6.15	+ 8 15.85	+1.22	— 38	+17	23.01	+3	64.8
	6		18.9907	22.1530	+ 11	— .7	—1.9	40 37 42.81	— 1 19.90	+ 2	— 35	— 3	22.55	+3	
	7		12.2647ii	28.0880iv	— 4	+ .5	+ .4	40 29 41.71	+ 6 39.63	+1.14	+ 13	+11	22.72	+3	
	8		20.9447	20.2647	0	+ .5	— .5	40 36 5.80	+ 17.18	+ 11	+ 2	+ 1	23.12	+2	64.1
	9		28.7693	15.0833	+155	—1.1	— .9	40 30 37.17	+ 5 46.06	+ 31	— 29	+11	23.36	+2	
	10		5.5113ii	33.2890iv	— 27	— .9	— .5	40 48 5.98	—11 41.50	—1.20	— 21	—23	22.84	+2	62.2
	11		26.5710	11.0720	—107	—1.4	—2.0	40 42 54.55	— 6 31.18	— 21	— 48	—11	22.57	+2	
	IX 1		29.6677	14.0477	+171	— .9	—1.4	40 29 47.87	+ 6 34.94	+ 33	— 32	+12	22.94	+1	61.4
	2		23.2290	15.5023	— 29	— .6	— .8	40 39 38.70	— 3 15.08	— 7	— 20	— 5	23.30	0	
	3		17.4573	23.8547	+ 24	—1.7	—1.6	40 39 5.75	— 2 41.64	— 5	— 47	— 4	23.55	0	59.4
	4		18.9380	20.2020	— 3	— .9	—1.0	40 35 51.24	+ 31.92	+ 8	— 27	+ 1	22.98	0	
	5		17.4963	20.7197	— 18	— .8	—3.0	40 37 44.48	— 1 21.37	+ 2	— 50	— 3	22.60	—1	59.9
	6		20.6040	19.2453	0	— .7	—1.4	40 36 57 63	— 34.32	+ 7	— 28	— 1	23.09	—1	
	7		7.8903ii	31.8253iv	— 4	—2.7	—2.5	40 46 29.19	—10 4.51	—1.15	— 74	—18	22.61	—1	59.0
May															
11	XI 2	R	9.9293ii	34.1410iv	+ 52	—1.3	—2.3	40 46 37.68	—10 11.66	—1.11	— 50	—23	24.18	—5	58.4
	3		6.6143ii	32.0237iv	— 23	—1.4	—1.6	40 25 40.25	+10 41.72	+1.30	— 42	+18	23.03	—6	
	4		7.8627ii	33.0940iv	+ 15	— .6	—1.3	40 25 45.07	+10 37.31	+1.29	— 26	+19	23.60	—6	
	5		1.2650ii	34.3587iv	—168	—2.2	—2.0	40 22 26.58	+13 55.44	+1.44	— 60	+26	23.12	—6	57.3
	6		27.0500	15.0750	+ 75	— .8	—1.2	40 31 20.78	+ 5 2.64	+ 27	— 28	+10	23.51	—6	
	7		19.7153	22.8753	+ 24	+ .2	— .3	40 37 43.00	— 1 19.87	+ 1	— 1	— 2	23.11	—7	56.1
	8		21.5007	20.4580	+ 8	—1.6	—2.9	40 36 49.39	— 26.36	+ 4	— 62	— 1	22.44	—7	
	I 1		16.5720	23.8003	+ 8	— .4	—1.2	40 33 20.31	+ 3 2.58	+ 18	— 22	+ 5	22.90	—7	
	2		13.8487	26.9537	+ 31	—4.0	—1.9	40 41 55.10	— 5 31.08	— 16	— 88	—10	22.88	—8	55.4
	3		16.7720	23.2180	0	—2.4	—3.0	40 33 41.26	+ 2 42.81	+ 17	— 76	+ 5	23.53	—8	55.0

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
May 11	I 4	D	22.8077	18.0610	+ 13	—2.0	—1.9	40 34 23.80	+ 1 59 92	+ 14	— 56	+ 3	40 36 23.33	—8	55.2
May 12	VIII 1		17.6217	20.9970	— 15	+ .6	+ 1.4	40 37 47.92	— 1 25.21	+ 1	+ 27	— 3	22.96	+4	69.3
	2		23.9827	11.8660	—149	— .2	— .1	40 31 16.72	+ 5 5.64	+ 30	— 4	+11	22.73	+4	68.4
	3		25.4617	12.9897	— 57	— .2	— .7	40 41 37.83	— 5 14.84	— 15	— 12	— 9	22.63	+ 4	
	4		25.0063	16.7697	+ 42	— .8	—1.0	40 32 54.67	+ 3 28.13	+ 19	— 25	+ 6	22.80	+4	67.9
	5		10.6020[II]	30.2143[IV]	0	— .2	— .8	40 28 6.49	+ 8 15.32	+ 1.22	— 13	+17	23.07	+ 3	
	6		20.5830	17.4090	— 19	—1.2	+ .4	40 37 43.18	— 1 20.12	+ 2	— 14	— 3	22.91	+ 3	66.3
	7		27.7487[IV]	11.9270[II]	+ 4	—2.3	—2.2	40 29 42.12	+ 6 39.60	+1.14	— 64	+ 11	23.33	+3	
	8		21.4780	22.1573	+ 8	—1.6	—2.0	40 36 6.16	+ 17.18	+ 11	— 50	+ 1	22.96	+3	65.4
	9		12.2057	25.8917	— 78	—2.0	—3.0	40 30 37.57	+ 5 45.54	+ 31	— 70	+11	22.83	+ 2	
	10		32.0523[IV]	4.2320[II]	— 83	+ .5	+ .1	40 48 6.40	—11 42.41	—1.20	+ 10	—23	22.66	+2	
	11		12.8330	28.3297	+ 52	—1.2	—2.6	40 42 55.03	— 6 31.51	— 21	— 52	—11	22.68	+ 2	63.9
	IX 1		12.0830	27.6887	— 12	— .5	—1.0	40 29 48.33	+ 6 34.10	+ 33	— 20	+ 12	22.68	+ 2	63.6
	2		15.0503	22.8333	— 48	+1.7	+ 2.4	40 39 39.23	— 3 16.44	— 7	+ 57	— 5	23.24	+1	63.5
	3		22 6843	16.2353	— 20	+ .7	+ .1	10 39 6.29	— 2 42.83	— 5	+ 12	— 4	23.49	+1	
May 19	4		20.2263	18.9613	— 2	— .7	—1.8	40 35 51.80	+ 31.95	+ 8	— 34	+ 1	23.50	+1	62.4
	VIII 2	R	13.8807	25.9780	— 6	— .4	— .6	40 31 17.21	+ 5 5.54	+ 30	— 14	+ 3	22.94	+4	58.1
	3		13.8330	26.2790	+ 5	—2.4	—3.2	40 41 38.52	— 5 14.37	— 15	— 78	— 9	23.13	+5	
	5		30.4550[IV]	10.8530[II]	0	0	— .4	40 28 7.26	+ 8 15.10	+1.22	— 5	+17	23.70	+4	56.8
	6		20.3737	23.5530	+ 37	—2.4	—3.3	40 37 44.06	— 1 20.39	+ 2	— 80	— 3	22.86	+ 4	
	7		11.7143[II]	27.4960[IV]	+ 11	— .3	— .6	40 29 43.11	+ 6 38.64	+1.13	— 12	+ 11	22.87	+ 4	
	8		21.9757	21.3457	+ 7	+ .3	— .1	40 36 7.01	+ 15.93	+ 11	+ 4	+ 1	23.10	+3	56.2
	9		28.9080	15.3157	+ 168	—1.8	—1.9	40 30 38.58	+ 5 43.73	+ 31	— 52	+11	22.21	+ 3	
	10		4.4593[II]	32.3080[IV]	— 75	+ .4	+ .1	40 48 7.50	—11 43.21	—1.20	+ 8	—23	22.94	+ 3	56.4
	11		28.8623	13.2940	+ 99	+3.3	+2.1	10 42 56.32	— 6 33.47	— 21	+ 79	—11	23.32	+3	56.5
	IX 1		28.6197	13.0857	+ 79	—2.0	+ .8	10 29 49.61	+ 6 32.55	+ 33	— 22	+12	22.39	+2	
	2		23.5453	15.7063	— 18	+ 1.2	+ .5	40 39 40.76	— 3 17.95	— 7	+ 26	— 5	22.95	+ 2	
	3		17.1387	23.6517	+ 15	—1.0	— .6	40 39 7.90	— 2 44.62	— 5	— 24	— 4	22.95	+2	
	4		20.1530	21.2877	+ 4	+1.7	+ 1.7	40 35 53.48	+ 28.67	+ 8	+ 48	+ 1	22.72	+1	54.8
	5		20.6760	24.0070	+ 45	— .2	+ .6	40 37 46.59	— 1 24.24	+ 2	+ 4	— 3	22.38	+ 1	54.5
	6		22.6467	21 2150	+ 17	—2.0	—2.2	40 36 59.70	— 36.21	+ 7	— 60	— 1	22.95	0	
	7		8.9667[II]	32.9853[IV]	+ 21	+ .3	—1.0	40 46 31.56	—10 6.72	—1.15	— 8	—18	23.43	0	53.2
	XI 2	D	30.0650[IV]	5.7357[II]	— 54	— .8	—1.7	40 46 39.68	—10 14.39	—1.11	— 34	—24	23.60	—4	49.8
	4		31.8067[IV]	6.6333[II]	— 24	—4.1	—5.6	40 25 47.28	+10 35.79	+1.29	—1.36	+19	23.19	—5	
	5		33.8057[IV]	0.8200[II]	—208	— .7	—1.0	40 22 28 72	+ 13 52.66	+1.44	— 24	+ 25	22.83	—5	
	6		13.1870	25.0813	— 61	—1.2	—2.4	40 31 22.87	+ 5 0.28	+ 27	— 49	+10	23.03	—5	49.8
	7		22.1467	18.9150	+ 10	+ .2	— .5	40 37 45.13	— 1 21.66	+ 1	— 4	— 2	23.42	—6	
	8		20.2217	21.3753	+ 5	— .3	— .4	40 36 51.49	— 29.15	+ 4	— 10	— 1	22.27	—6	
	I 1		23.1273	16.0283	— 18	+ .7	+ .5	40 33 22.38	+ 2 59.27	+ 18	+ 18	+ 5	22.06	—7	
	2		26.8983	13.6387	+ 21	+ 2.7	+1.1	40 41 57.09	— 5 34.98	— 16	+ 57	—10	22.42	—7	47.6
	4		17.8350	22.5010	+ 4	—1.0	—1.7	40 34 25.69	+ 1 57.87	+ 14	— 38	+ 3	23.35	—7	47.2
	5		17.7057	23.6163	+ 22	+ .8	— .7	40 33 54.12	+ 2 29.36	+ 16	+ 4	+ 4	23.72	—7	
May 31	6		19.1873	20.8890	+ 1	—2.2	—2.2	40 35 41.10	+ 42.99	+ 12	— 62	+ 1	23.60	—7	47.8*a*
	VIII 6	D	21.9127	18.6653	+ 6	— .5	—1.1	40 37 45.57	— 1 22.03	+ 2	— 22	— 3	23.31	+5	67.0
	7		28.8120[IV]	13.0580[II]	— 21	—2.4	—3.9	10 29 44.78	+ 6 37.82	+ 1.13	— 87	+11	22.97	+ 5	65.6
	9		12.7703	26.3447	— 36	—1.7	—3.3	40 30 40.30	+ 5 42.74	+ 31	— 68	+ 11	22.78	+5	64.7
	10		32.3707[IV]	4.4617[II]	— 73	+ .6	— .2	40 48 9.36	—11 44.69	—1.20	+ 7	—23	23.31	+ 4	64.4
	11		12.8487	28.4797	+ 62	—1.3	—1.6	40 42 58.54	— 6 34.91	— 21	— 40	—11	22.88	+5	
	IX 1		11.9247	27.3793	— 32	+ .2	+ .2	40 29 51.77	+ 6 30.25	+ 33	+ 6	+ 12	22.53	+ 4	63.9
	2		17.3427	25.2393	+ 59	—1.5	—1.5	40 39 43.37	— 3 19.58	— 7	— 43	— 5	23.24	+3	63.4
	3		23.3790	16.7537	+ 3	+ .5	+ .3	40 39 10.60	— 2 47.34	— 5	+ 12	— 4	23.29	+3	63.0
	4		21.9333	20.8810	+ 8	—1.0	— .5	40 35 56.34	+ 26.60	+ 8	— 22	+ 1	22.81	+3	
	5		21.9207	18.4820	+ 4	0	— .3	40 37 50.03	— 1 26.86	+ 1	— 4	— 3	23.11	+2	62.2
	6		19.6980	21.2607	+ 4	— .8	—1.9	10 37 2.38	— 39.48	+ 6	— 36	— 1	22.59	+ 2	
	7		32.8760[IV]	8.7363[II]	+ 20	+ .3	+1.0	40 46 34.60	—10 9.73	—1.16	+ 18	—18	23.71	+ 2	61.2

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
June 7	VIII 8	R	21.7437	21.1797	+ 5	— .9	—2.3	40 36 9.08	+ 14.26	+ 11	— 44	+ 1	40 36 23.02	+5	67.4
	9		28.3870	14.8573	+130	— .5	—1.2	40 30 41.04	+ 5 42.03	+ 31	— 23	+11	23.26	+5	65.6
	10		3.2980ii	31.2300iv	—129	— .4	— .6	40 48 10.17	—11 45.13	—1.20	— 14	—23	23.47	+5	65.3
	11		28.2743	12.6007	+ 40	— .3	— .6	40 42 59.54	— 6 35.95	— 21	— 12	—11	23.15	+5	
	IX 1		29.0810	13.6600	+124	—2.6	—2.9	40 29 52.75	+ 6 29.78	+ 33	— 78	+12	22.20	+5	65.1
	2		23.8683	15.8707	— 7	+1.8	+ .8	40 39 44.61	— 3 21.97	— 7	+ 38	— 5	22.90	+4	
	3		16.1897	22.8610	— 18	—1.1	—1.3	40 39 11.91	— 2 48.45	— 5	— 34	— 4	23.03	+4	63.9
	4		20.0790	21 0760	+ 4	— .6	—1.1	40 35 57.72	+ 25.19	+ 8	— 24	+ 1	22.76	+4	63.3
	5		19.3697	22.8347	+ 22	— .3	— .5	40 37 50.60	— 1 27.57	+ 1	— 12	— 3	22.89	+3	
	6		21.8313	20.2277	+ 9	— .3	—2.0	40 37 3.64	— 40.52	+ 6	— 30	— 1	22.87	+3	
	7		8.2877ii	32.4893iv	+ 10	—1.8	—1.2	40 46 36.11	—10 11.26	—1.16	— 44	—18	23.07	+3	63.0
	XI 6	R	27.2097	15.5263	+ 94	—1.1	—1.5	40 31 27.87	+ 4 55.33	+ 27	— 36	+10	23.21	—3	58.8
	7		18.7077	22.1347	+ 8	—2.9	—2.8	40 37 50.34	— 1 26.58	0	— 82	— 2	22.92	—3	58.8
	8		20.3923	19.0943	0	—1.5	—3.2	40 36 56.64	— 32.79	+ 4	— 64	— 1	23.24	—4	58.4
	I 2		13.8943	27.2770	+ 47	—2.4	—1.6	40 42 2.06	— 5 38.13	— 17	— 58	—10	23.08	—4	58.2
	3		17.5137	23.6683	+ 20	— .5	—1.1	40 33 48.06	+ 2 35.50	+ 16	— 22	+ 4	23.54	—5	
	4		23.1403	18.6497	+ 23	—3.1	—3.3	40 34 30.47	+ 1 53.48	+ 14	— 91	+ 3	23.21	—5	
	5		22.0753	16.3227	— 28	—2.5	—1.7	40 33 58.79	+ 2 25.23	+ 15	— 61	+ 4	23.60	—5	
	6		21.3693	19.8510	+ 5	—3.5	—2.3	40 35 45.25	+ 38.36	+ 12	— 84	+ 1	22.90	—5	57.4
	7		11.5643	31.2347	+162	—2.7	—2.8	40 28 5.97	+ 8 17.23	+ 40	— 78	+16	22.98	—6	
	8		8.7453ii	33.4143iv	+ 30	— .4	—1.0	40 25 59.16	+10 23.15	+1.29	— 19	+18	23.59	—6	56.6
	9		15.4950	28.3347	+ 146	— .5	— .2	40 30 58.40	+ 5 24.67	+ 28	— 10	+ 9	23.34	—6	
June 8	10		26.4940	15.9777	+ 78	+1.0	+ .7	40 40 49.69	— 4 25.81	— 5	+ 25	—11	23.97	—5	56.4
	IX 1	D	11.9743	27.3940	— 27	— .7	+ .6	40 29 52.92	+ 6 29.37	+ 33	+ 18	+12	22.92	+5	68.5
	2		16.0317	24.0150	0	— .4	— .5	40 39 44.81	— 3 21.63	— 7	— 13	— 5	22.93	+4	67.5
	3		23.1670	16.4580	— 7	+1.6	+1.9	40 39 12.12	— 2 49.42	— 5	+ 50	— 4	23.11	+4	67.4
	4		19.8590	18.8870	— 4	— .1	— .6	40 35 57.96	+ 24.54	+ 8	— 9	+ 1	22.50	+4	67.3
	5		21.3703	17.8563	+ 7	+2.3	+1.6	40 37 50.83	— 1 28.73	+ 1	+ 56	— 3	22.64	+3	
	6		18.8667	20.5013	— 2	— .5	— .7	40 37 3.86	— 41.27	+ 6	— 17	— 1	22.47	+3	67.2
	7		32.3417iv	8.1087ii	+ 6	+ .8	+ .6	40 46 36.37	—10 12.04	—1.16	+ 20	—18	23.19	+3	
	X 1		14.0763	27.0550	+ 43	—1.0	—2.0	40 41 51.00	— 5 27.90	— 16	— 41	—10	22.43	+3	66.4
	2		8.7703ii	28.4853iv	+ 3	— .2	— .5	40 28 4.19	+ 8 17.92	+1.22	— 10	+16	23.39	+2	65.6
	3		18.8923	21.1660	0	+ .2	+ .4	40 35 25.47	+ 57.42	+ 10	+ 8	+ 2	23.09	+2	65.6
	4		12.6433	27.4837	+ 6	— .1	+ .1	40 30 7.26	+ 6 14.82	+ 32	0	+10	22.50	+2	
	5		30.2187iv	8.8697ii	— 3	+ .2	— .6	40 45 23.77	— 8 59.18	—1.06	— 4	—21	23.28	+1	65.4
	6		22.3867	18.4177	+ 10	0	+ .2	40 34 42.26	+ 1 40.26	+ 14	+ 2	+ 3	22.71	+1	65.1
	7		14.9813	25.7473	+ 23	+1.0	+ .3	40 31 51.10	+ 4 31.96	+ 24	+ 20	+ 8	23.58	+1	64.0
	8		29.7143	9.4127	— 54	—1.6	—2.1	40 44 56.55	— 8 32.60	— 28	— 52	—15	23.00	0	62.6
	9		28.1360	10.0680	— 96	— .2	—1.4	40 44 0.12	— 7 36.08	— 23	— 20	—14	23.47	0	
	10		6.9803ii	31.6510iv	— 18	—1.3	—2.3	40 46 47.83	—10 23.03	—1.17	— 50	—18	22.95	—1	61.9
	XI 6	D	12.1607	23.8410	—138	— .3	— .5	40 31 28.17	+ 4 54.66	+ 27	— 12	+10	23.08	—3	61.1
	7		20.2720	16.8103	— 30	— .1	—1.1	40 37 50.65	— 1 27.36	0	— 16	— 3	23.10	—3	60.4
	I 1		22.5227	15.5837	— 39	—1.4	—3.2	40 33 27.82	+ 2 55.16	+ 18	— 63	+ 5	22.58	—4	60.9
	3		22.9583	16.8180	— 4	— .6	—1.4	40 33 48.35	+ 2 35.07	+ 16	— 27	+ 4	23.35	—5	60.1
	4		16.8807	21.3900	— 23	—2.1	—4.2	40 34 30.76	+ 1 53.84	+ 14	— 86	+ 3	23.91	—5	59.4
	5		17.3583	23.0697	+ 8	— .8	— .3	40 33 59.07	+ 2 24.27	+ 16	— 16	+ 4	23.38	—5	59.3
	6		18.3590	19.8440	— 7	— .7	—1.1	40 35 45.51	+ 37.49	+ 11	— 25	+ 1	22.87	—5	
	7		28.6483	8.9970	—136	— .2	—1.7	40 28 6.23	+ 8 15.98	+ 40	— 24	+15	22.52	—5	
	8		32.4160iv	7.7770ii	+ 3	— .8	— .1	40 25 59.42	+10 22.31	+1.28	— 14	+18	23.05	—6	59.4
	9		26.1363	13.2997	— 21	— .2	— .3	40 30 58.66	+ 5 24.16	+ 28	— 7	+ 9	23.12	—6	59.0
June	10		13.3707	23.9040	— 84	—1.2	—3.2	40 40 49.89	— 4 25.83	— 5	— 60	—11	23.30	—5	38.6
9	IX 1	R	28.1683	12.7740	+ 42	+1.1	+1.1	40 29 53.09	+ 6 28.89	+ 38	+ 32	+12	22.80	+5	71.9
	2		24.2237	16.2130	+ 10	+1.5	+1.5	40 39 45.02	— 3 22.33	— 10	+ 43	— 6	22.96	+5	71.3
	3		16.5687	23.2800	— 3	+ .4	0	40 39 12.34	— 2 49.49	— 7	+ 6	— 5	22.79	+4	71.0
	4		19.3980	20.3527	+ 1	+ .7	+ .7	40 35 58.19	+ 24.12	+ 8	+ 20	0	22.59	+4	69.5

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
June 9	IX 5	R	19.0763	22.5790	+ 18	— .5	— .6	40 37 51.05	— 1 28.50	0	— 16	— 3	10 36 22.36	+4	68.4
	6		20.0703	18.4383	— 8	— .5	—1.0	40 37 4.09	— 41.19	+ 6	— 20	— 1	22.75	+3	
	7		8.1177[ii]	32.3580[iv]	+ 7	—1.0	— .5	40 46 36.63	—10 12.21	—1.21	— 22	—18	22.78	+3	67.4
	X 1		26.7783	13.7693	+ 20	+1.3	+1.4	40 41 51.28	— 5 28.59	— 20	+ 38	— 9	22.78	+ 3	67.2
	2		32.0857[iv]	12.3773[ii]	— 5	— .1	+ .8	40 28 4.44	+ 8 17.73	+ 1.29	+ 8	+17	23.71	+ 2	
	3		21.2720	19.0003	+ 2	+1.0	+ .5	40 35 25.74	+ 57.38	+ 11	+ 22	+ 2	23.47	+ 2	67.6
	4		27.4523[iv]	12.6433[ii]	— 1	— .3	— .9	40 30 7.54	+ 6 14 00	+ 1.18	— 16	+ 10	22.66	2	67.1
	5		10.0050[ii]	31.3597[iv]	+ 5	—1.1	0	40 45 24.01	— 8 59.34	—1.13	— 18	—21	23.15	+2	66.6
	6		19.3683	23.3450	+ 32	+1.0	+1.3	40 34 42.54	+ 1 40.51	+ 15	+ 32	+ 3	23.55	+ 1	66.4
	7		25.8140	15.0767	+ 27	—1.0	—1.0	40 31 50.56	+ 4 31.24	+ 28	+ 28	+ 8	22.44	+1	66.5
	8		9.9963	30.2960	+ 19	— .8	—1.5	40 44 56.86	— 8 32.72	— 35	— 32	—14	23.33	0	66.1
	9		11.0227	39.0617	+ 4	—2.8	—2.3	40 44 0.44	— 7 35.59	— 29	— 74	—14	23.68	0	
	10		32.4137[iv]	7.7130[ii]	+ 1	—2.0	—4.0	40 46 48.16	—10 23.82	—1.25	— 82	—18	22.09	—1	65.1
	XI 6	R	26.7087	15.0627	+ 61	— .8	— .7	40 31 28.48	+ 4 54.29	+ 31	— 22	+10	22.96	—3	63.4
	7		18.6153	22.0900	+ 7	+ .9	+ .8	40 37 50.97	— 1 27.78	— 1	+ 24	— 3	23.39	—3	62.9
	8		20.8107	19.4663	0	+ .2	— .5	40 36 57.27	— 33.96	+ 3	— 4	— 1	23.29	—4	62.6
	I 1		15.9007	22.8393	— 26	+ .3	— .6	40 33 28.15	+ 2 55.18	+ 20	— 2	+ 5	23.56	—4	
	2		12.5277	25.9607	— 61	—2.2	—1.9	40 42 2.67	— 5 39.12	— 21	— 59	—10	22.65	—4	62.6
	3		17.5747	23.7047	+ 23	—1.2	—2.9	40 33 48.66	+ 2 34.88	+ 18	— 56	+ 4	23.20	—5	
	4		21.6847	17.2277	— 15	—2.1	—1.7	40 34 31.07	+ 1 52.53	+ 15	— 55	+ 3	23.23	—5	62.5
	5		22.8370	17.1357	— 2	—1.9	—1.4	40 33 59.38	+ 2 23.99	+ 18	— 48	+ 4	23.11	—5	61.9
	6		20.5423	19.0390	0	—2.6	—1.4	40 35 45.78	+ 37.96	+ 12	— 59	+ 1	23 28	—5	
	7		10.3987	30.0340	+ 21	—1.7	—2.3	40 28 6.52	+ 8 15.98	+ 47	— 56	+15	22.56	—5	60.9
	8		6.8403[ii]	31.4633[iv]	— 23	+ .2	— .7	40 25 59.70	+10 21.83	+1.37	— 6	+18	23.02	—6	
	9		13.8923	26.7270	+ 22	— .3	—1.7	40 30 58.94	+ 5 24.22	+ 32	— 26	+ 9	23.31	—6	60.8
June 11	10		27.3310	16.8160	+128	—1.6	—2.6	40 40 50.12	— 4 25.90	— 9	— 58	—11	23.44	—5	60.5
	IX 1	D	12.6123	27.9910	+ 26	+ .6	+ .3	40 29 53.37	+ 6 28.45	+ 38	+ 14	+12	22.46	+5	76.5
	2		15 5727	23.5323	— 21	—4.0	—3.9	40 39 45.39	— 3 20.96	— 10	—1.12	— 6	23.15	+5	75.4
	3		20.8217	14.0940	—100	— .1	— .3	40 39 12.75	— 2 49.66	— 7	— 6	— 5	22.91	+ 5	74.9
	4		19.9867	19.0420	— 3	0	— .5	40 35 58.63	+ 23 86	+ 8	— 6	0	22.51	+4	74.2
	5		20.3433	16.8393	— 29	+ .1	— .5	40 37 51.47	— 1 28.42	0	— 5	— 3	22.97	+ 4	
	6		18.1320	19.7853	— 10	—1.0	—1.4	40 37 4.51	— 41.73	+ 6	— 34	— 1	22.49	+3	73.3
	7		31.9410[iv]	7.6810[ii]	— 6	— .2	— .3	40 46 37.11	—10 12.66	—1.24	— 7	—18	22.96	+4	
	X 1		13.4880	26.4967	+ 1	—2.2	—2.8	40 41 51.79	— 5 28.53	— 20	— 70	— 9	22.27	+3	72.3
	2		9.2520[ii]	28.9413[iv]	0	— .2	— .1	40 28 4.93	+ 8 17.25	+ 1.29	— 4	+ 17	23.60	+3	
	3		18.0853	20.3410	— 10	— .8	— .8	40 35 26.28	+ 56.94	+ 11	— 22	+ 2	23.13	+3	
	4		12.5707[ii]	27.3590[iv]	0	+ .1	— .3	40 30 8.11	+ 6 13.47	+1.18	— 2	+ 10	22.84	+2	
	5		29.1963[iv]	7.8100[ii]	— 12	— .4	—1.7	40 45 24.51	— 9 0.07	—1.13	— 28	—21	22.82	+ 2	70.4
	6		21.5700	17.6160	— 10	+ .2	— .5	40 34 43.11	+ 1 39.83	+ 15	— 4	+ 3	23.08	+1	70.0
	XI 6	D	13.0660	24.6877	— 76	+ .9	+ .7	40 31 29.14	+ 4 53.32	+ 31	+ 22	+ 10	23.09	—2	68.9
June 13	7		21.0693	17.5733	— 14	—1.3	—2.3	40 37 51.66	— 1 28.24	— 1	— 50	— 3	22.88	—3	66.6
	IX 1	R	28.3190	12.9160	+ 55	—1.6	—1.7	40 29 53.58	+ 6 29.15	+ 38	— 47	+12	22.76	+5	69.5
	2		23.4197	15.3933	— 28	+ .2	+ .5	40 39 45.70	— 3 22.64	— 10	+ 10	— 6	23.00	+5	68.9
	3		15.8130	22.5320	— 33	—1.5	—1.3	40 39 13.08	— 2 49.61	— 7	— 40	— 5	22.95	+5	68.6
	4		19.5833	20.5243	0	+ .4	+ .3	40 35 59.00	+ 23.77	+ 2	+ 10	+ 6	22.95	+5	68.4
	5		18.7443	22.2450	+ 10	—1.7	—1.2	40 37 51.82	— 1 28.44	0	— 42	— 3	22.93	+ 4	67.6
	6		21.9213	20.2893	+ 10	—1.0	—1.7	40 37 4.87	— 41.21	+ 6	— 38	— 1	23.30	+4	67.4
	7		8.6700[ii]	32.9203[iv]	+ 20	—3.0	—1.9	40 46 37.54	—10 12.51	—1.24	— 72	—18	22.89	+ 4	66.9
	X 1		27.5730	14.5330	+ 82	— .6	—1.2	40 41 52.25	— 5 29.54	— 20	— 24	— 9	22.18	+ 3	66.6
	2		30.5930[iv]	10.9057[ii]	0	—1.2	—1.7	40 28 5.35	+ 8 17.22	+1.29	— 40	+ 17	23.63	+3	
	3		21.5747	19.3277	+ 6	—1.3	—1.1	40 35 26.77	+ 56.75	+ 10	— 34	+ 2	23.30	+3	
	4		27.1210[iv]	12.3423[ii]	+ 10	—1.7	— .3	40 30 8.62	+ 6 13.27	+1.18	— 31	+ 10	22.86	+3	67.0
	5		9.6930[ii]	31.0853[iv]	+ 2	—2.6	—2.4	40 45 24.94	— 9 0.28	—1.13	— 72	—21	22.60	+ 2	66.4
	6		19.8640	22.7950	+ 20	0	— .5	40 34 43.62	+ 1 39.33	+ 15	— 6	+ 3	23.07	+2	
	7		26.3350	15.6623	+ 63	+ .6	+ .2	40 31 52.60	+ 4 29.71	+ 28	+ 12	+ 8	22.79	+1	66.4

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
June								° ′ ″					° ′ ″		
13	X 8	R	10.7137	31.0580	+105	—1.1	— .9	40 44 58.04	— 8 34.08	— 35	— 29	—14	40 36 23.18	+1	65.9
	9		12.3917	30.5170	+156	+ .5	+ .5	40 44 1.64	— 7 38.16	— 30	+ 14	—14	23.18	+1	65.4
June	10		31.5910iv	6.8497ii	— 22	— .6	—3.1	40 46 49.44	—10 24.80	—1.25	— 48	— 8	22.83	0	64.9
14	I 1	D	24.1450	17.3030	+ 28	0	— .5	40 33 29.83	+ 2 52.87	+ 20	— 6	+ 5	22.89	—3	67.6
	2		25.4590	11.9317	—102	+ .4	+ .2	40 42 4.34	— 5 41.39	— 21	+ 9	—10	22.73	—3	66.9
	3		23.5160	17.4730	+ 17	+ .1	+ .2	40 33 50.33	+ 2 32.67	+ 18	+ 4	+ 4	23.26	—4	
	4		17.1627	21.5283	— 17	— .1	—1.7	40 34 32.72	+ 1 50.21	+ 15	— 23	+ 3	22.88	—4	66.6
	5		17.3800	23.0133	+ 6	+ .1	+ .2	40 34 1.02	+ 2 22.29	+ 18	+ 4	+ 4	23.57	—5	66.9
	6		18.5970	20.0103	— 6	+ .3	0	40 35 47.27	+ 35.67	+ 12	+ 5	+ 1	23.12	—4	
	7		29.6727	10.1053	— 14	— .5	— .2	40 28 8.05	+ 8 14.15	+ 46	— 10	+15	22.71	—5	
	8		31.9570iv	7.4080ii	— 9	— .3	+ .4	40 26 1.28	+10 19.98	+1.36	0	+18	22.80	—5	66.6
	9		27.2553	14.5013	+ 68	0	+1.3	40 31 0.49	+ 5 22.28	+ 32	+ 16	+ 9	23.34	—6	
June	10		13.6583	24.2913	— 64	+1.1	+1.0	40 40 51.43	— 4 28.38	— 9	+ 30	—11	23.15	—5	66.3
17	I 1	R	15.6817	22.5110	— 36	—1.0	—1.2	40 33 30.71	+ 2 52.40	+ 20	— 31	+ 5	23.05	—3	60.9
	2		13.4490	26.9570	+ 16	—1.3	—2.5	40 42 5.21	— 5 41.21	— 21	— 52	—10	23.17	—3	61.1
	3		16.7950	22.8210	— 7	— .4	— .3	40 33 51.20	+ 2 32.18	+ 18	— 10	+ 4	23.50	—3	60.9
	4		22.2400	17.8987	+ 1	— .3	+ .1	40 34 33.60	+ 1 49.65	+ 15	— 4	+ 3	23.39	—4	
	5		23.0067	17.4190	+ 6	— .7	—1.6	40 34 1.89	+ 2 21.14	+ 17	— 31	+ 4	22.93	—4	60.8
	6		22.8443	21.4613	+ 17	—1.7	— .8	40 35 48.06	+ 34.98	+ 12	— 37	+ 1	22.80	—4	
	7		11.7253	31.2367	+171	+2.2	+1.4	40 28 8.87	+ 8 13.22	+ 46	+ 52	+15	23.22	—4	
	8		8.7780ii	33.3047iv	+ 29	+ .5	— .8	40 26 2.14	+10 19.54	+1.36	— 2	+18	23.20	—5	
	9		13.4150	26.1447	— 16	+1.2	+ .4	40 31 1.35	+ 5 21.47	+ 32	+ 24	+ 9	23.47	—5	60.6
	10		26.8893	16.2657	+100	+ .8	+1.5	40 40 52.13	— 4 28.57	— 9	+ 32	—11	23.68	—5	
	II 1		21.8517	22.1893	+ 5	— .6	0	40 36 31.44	— 8.54	+ 12	— 10	0	22.92	—5	
	2		22.2000	22.4437	+ 3	+2.0	+2.8	40 36 16.49	+ 6.16	+ 10	+ 68	0	23.43	—5	60.6
	3		29.7107	11.8367	+ 82	—1.0	— .2	40 28 50.87	+ 7 31.65	+ 43	— 18	+13	22.90	—6	61.1
June	4		20.6523	24.4223	+ 56	+1.3	+1.9	40 37 57.42	— 1 35.36	+ 2	+ 44	— 3	22.49	—6	60.9
20	IX 3	D	23.5623iv	16.7420ii	—393	+ .6	+1.1	40 39 14.04	— 2 51.24	— 8	+ 24	— 5	22.91	+6	83.8
	5		20.2863	16.6983	— 32	— .3	+ .2	40 37 53.58	— 1 30.52	0	— 2	— 3	23.01	+5	84.4
	6		18.6320	20.3310	— 5	—1.0	—1.9	40 37 5.93	— 42.89	+ 6	— 40	— 1	22.69	+4	
	7		32.7687iv	8.4620ii	+ 16	0	+ .6	40 46 38.77	—10 13.85	—1.24	+ 8	—18	23.58	+5	83.9
	X 1		13.6043	26.7057	+ 12	+ .5	+1.0	40 41 53.64	— 5 30.88	— 20	+ 20	— 9	22.67	+4	
	2		9.3763ii	28.9913iv	0	— .2	— .4	40 28 6.59	+ 8 15.33	+1.29	— 8	+17	23.30	+4	83.4
	3		19.0643	21.2557	+ 2	— .3	— .1	40 35 28.17	+ 55.34	+ 10	— 6	+ 2	23.57	+4	
	4		12.9447	27.6500	+ 27	+ .1	0	40 30 10.12	+ 6 11.42	+ 37	+ 2	+10	22.03	+4	83.5
	5		30.3617iv	8.9107ii	— 3	+1.5	+ .9	40 45 26.17	— 9 1.69	—1.13	+ 36	—21	23.50	+3	83.2
	6		22.0080	18.1397	+ 1	— .1	+ .3	40 34 45.11	+ 1 37.68	+ 15	+ 2	+ 3	22.99	+3	82.7
	7		14.3770	25.0233	— 18	+ .2	—1.3	40 31 54.27	+ 4 28.81	+ 28	— 14	+ 8	23.30	+2	
	8		30.3980	9.9543	+ 22	+ .9	+1.1	40 44 59.71	— 8 36.27	— 35	+ 28	—14	23.23	+2	
	9		29.4010	11.1743	+ 31	+1.0	+1.8	40 44 3.34	— 7 40.35	— 30	+ 38	—14	22.93	+2	82.0
June	10		6.9473ii	31.7627iv	— 18	— .3	— .3	40 46 51.26	—10 26.61	—1.25	— 9	—18	23.13	+1	80.8
23	IX 3	R	16.2863	23.0393	— 13	—3.1	—2.8	40 39 14.58	— 2 50.52	— 8	— 85	— 4	23.09	+6	69.3
	4		18.9463	19.8590	— 4	—2.5	—3.6	40 36 0.65	+ 23.04	+ 8	— 85	0	22.92	+6	68.3
	5		19.3293	22.8783	+ 23	—1.8	—3.8	40 37 53.41	— 1 29.69	0	— 76	— 3	22.93	+5	
	6		22.4823	20.7810	+ 16	—1.9	—3.7	40 37 6.50	— 43.00	+ 6	— 76	— 1	22.79	+5	
	7		8.7083ii	33.0227iv	+ 22	—1.9	—3.3	40 46 39.43	—10 14.13	—1.24	— 72	—18	23.16	+5	67.1
	X 1		26.9540	13.8340	+ 32	+ .4	0	40 41 54.29	— 5 31.44	— 20	+ 6	— 9	22.62	+5	66.4
	2		31.1440iv	11.5647ii	— 4	+1.8	+ .6	40 28 7.25	+ 8 14.48	+1.29	+ 36	+16	23.54	+4	
	3		22.4313	20.3107	+ 17	+1.8	+2.9	40 35 28.91	+ 53.60	+ 10	+ 65	+ 2	23.28	+4	
	4		27.8917iv	13.2423ii	— 17	+1.2	+1.2	40 30 10.89	+ 6 9.94	+1.18	+ 34	+10	22.45	+4	
	5		10.4913ii	31.9447iv	+ 9	—2.1	—1.6	40 45 26.84	— 9 1.84	—1.13	— 54	—21	23.12	+3	65.9
	6		19.5380	23.3507	+ 32	+2.2	+1.9	40 34 45.88	+ 1 36.37	+ 15	+ 59	+ 3	23.02	+3	65.1
	7		26.3043	15.7270	+ 63	+1.5	+1.3	40 31 55.13	+ 4 27.30	+ 27	+ 40	+ 8	23.18	+3	66.4
	8		10.6707	31.1373	+109	— .1	+3.7	40 45 0.55	— 8 37.18	— 35	+ 45	—14	23.33	+2	
	9		11.1797	29.4040	+ 31	— .5	0	40 44 4.20	— 7 40.35	— 30	— 8	—14	23.33	+2	66.2

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
June								° ′ ″					° ′ ″		
23	X 10	R	33.2763iv	8.4173ii	+ 25	+1.3	+ .1	40 46 52.17	—10 27.89	—1.25	+ 22	—19	40 36 23.06	+2	66.1
	I 4	D	18.0063	22.2930	+ 4	—1.7	—1.8	40 34 35.36	+ 1 48.28	+ 15	— 50	+ 3	23.32	—3	62.5
	5		17.8153	23.3337	+ 19	+ .4	+ .6	40 34 3.63	+ 2 19.42	+ 17	+ 14	+ 4	23.40	—3	62.6
	6		18.0663	19.4287	— 9	—1.4	—3.2	40 35 49.62	+ 34.39	+ 12	— 63	+ 1	23.51	—3	
	8		31.6207iv	7.1690ii	— 16	— .6	— .6	40 26 3.82	+10 17.52	+1.36	— 17	+18	22.71	—4	61.5
	9		26.5480	13.9097	+ 17	+ .8	+ 1.4	40 31 3.00	+ 5 19.24	+ 31	+ 30	+ 9	22.94	—4	
	10		14.2050	24.8890	— 29	—2.5	—2.4	40 40 53.46	— 4 29.77	— 9	— 70	—11	22.79	—4	62.1
	II 1		19.4183	19.0180	0	+1.5	+ .3	40 36 32.75	— 10.11	+ 12	+ 28	0	23.04	—4	61.2
June	2		19.2223	19.0240	0	— .3	0	40 36 17.83	+ 5.01	+ 10	— 5	0	22.89	—5	60.8
24	IX 3	D	22.0947	15.3017	— 53	— .7	0	40 39 14.75	— 2 51.43	— 8	— 11	— 4	23.09	+6	70.4
	4		21.0437	20.1627	+ 3	+ .6	+ .5	40 36 0.85	+ 22.26	+ 8	+ 16	0	23.35	+ 6	
	5		21.5587	17.9527	— 4	+ 1.0	+ .3	40 37 53.57	— 1 31.06	0	+ 20	— 3	22.68	+ 5	69.4
	6		18.5973	20.3283	— 5	— .5	—1.5	40 37 5.94	— 43.70	+ 6	— 27	— 1	22.02	+ 5	
	7		32.4180iv	8.0760ii	+ 7	— .2	—1.1	40 46 39.65	—10 14.79	—1.24	— 17	—18	23.27	+5	67.8
	X 1		14.3093	27.4360	+ 68	+ .6	0	40 41 54.53	— 5 31.69	— 20	+ 10	— 9	22.65	+5	67.6
	3		18.5103	20.6667	— 5	+ .3	— .3	40 35 29.16	+ 54.45	+ 10	+ 1	+ 2	23.74	+4	67.4
	4		12.3460ii	27.0160iv	+ 11	+ .1	+ .4	40 30 11.15	+ 6 10.53	+ 1.18	+ 6	+ 10	23.03	+4	
	5		30.2443iv	8.7633ii	— 5	— .6	—1.1	40 45 27.07	— 9 2.50	—1.13	— 24	—21	22.99	+ 3	66.8
	6		21.0077	17.1453	— 22	—1.6	—2.5	40 34 46.15	+ 1 37.49	+ 15	— 57	+ 3	23.25	+3	66.6
	7		15.1433	25.7557	+ 28	—2.3	—3.2	40 31 55.42	+ 4 28.10	+ 28	— 77	+ 8	23.11	+ 3	65.9
	8		29.8363	9.3560	— 50	— .8	— .3	40 45 0.85	— 8 37.11	— 35	— 16	—14	23.09	+3	
	9		29.3647	11.1307	+ 28	—1.7	—2.6	40 44 4.50	— 7 40.58	— 30	— 60	—14	22.88	+2	65.1
June	10		6.4433ii	31.2977iv	— 33	—2.1	—3.3	40 46 52.49	—10 27.63	—1.25	— 75	—19	22.67	+2	64.6
28	I 5	R	22.9583	17.4777	+ 6	—1.5	—2.5	40 34 5.35	+ 2 18.44	+ 17	— 56	+ 4	23.44	—3	54.8
	6		22.6363	21.3697	+ 15	— .2	— .7	40 35 51.17	+ 32.03	+ 11	— 12	+ 1	23.20	—2	54.6
	7		11.5000	30.9350	+139	—1.5	—2.4	40 28 12.10	+ 8 11.24	+ 46	— 54	+ 15	23.41	—3	
	8		9.3090ii	33.7343iv	+ 40	—1.7	—2.6	40 26 5.50	+ 10 17.04	+1.36	— 60	+18	23.48	—3	54.6
	9		15.1450	27.7253	+107	+ 1.3	+ 1.3	40 31 4.67	+ 5 18.02	+ 31	+ 37	+ 9	23.46	—4	
	10		27.4343	16.7430	+132	—1.6	—2.0	40 40 54.86	— 4 30.37	— 9	— 50	—11	23.79	—4	
	II 1		21.6243	22.0480	+ 6	—1.3	—1.3	40 36 34.14	— 10.72	+ 12	— 37	0	23.17	—4	54.2
	2		21.4737	21.6243	0	+ .3	0	40 36 19.26	+ 3.80	+ 10	+ 5	0	23.21	—4	
	3		30.0330	12.2637	+ 119	—2.0	—1.9	40 28 53.74	+ 7 29.12	+ 43	— 56	+ 14	22.87	—5	53.6
	4		21.1680	25.0107	+ 70	— .9	— .7	40 38 0.07	— 1 37.23	+ 2	— 24	— 3	22.59	—5	
	5		30.5647iv	12.2340ii	— 13	—1.0	0	40 28 38.98	+ 7 42.97	+1.24	— 16	+ 13	23.16	—5	53.2
	6		9.9397ii	30.7207iv	0	— .5	—1.5	40 27 36.87	+ 8 44.88	+1.28	— 27	+14	22.90	—6	52.8
	7		29.7860iv	13.3857ii	— 31	— .2	+ .1	40 29 27.22	+ 6 54.07	+1.19	— 2	+ 12	22.58	—6	53.1
June	8		14.1653	28.7677	+ 126	+ 1.3	+2.3	40 42 32.49	— 6 9.15	— 22	+ 50	—10	23.52	—6	52.9
30	I 5	D	17.9690	23.3910	+ 23	+1.0	0	40 34 5.96	+ 2 17.01	+ 17	+ 16	+ 4	23.34	—2	60.1
	6		19.4397	20.6543	+ 1	+1.2	+1.9	40 35 51.73	+ 30.68	+ 11	+ 43	+ 1	22.96	—2	60.3
	7		30.6453	11.2793	+ 110	— .9	— .7	40 28 12.69	+ 8 9.41	+ 46	— 24	+15	22.47	—3	
	8		33.0570iv	8.7030ii	+ 23	— .2	+1.0	40 26 6.11	+10 15.17	+ 1.36	+ 10	+ 18	22.92	—3	60.1
	9		28.1040	15.5843	+ 136	+ 2.4	+1.2	40 31 5.29	+ 5 16.56	+ 31	+ 53	+ 9	22.78	—3	
	10		14.6523	25.4370	+ 3	+1.4	+1.6	40 40 55.37	— 4 32.40	— 9	+ 42	—11	23.19	—3	60.2
	II 1		19.5570	19.0677	0	+ 2.1	+1.5	40 36 34.66	— 12.36	+ 12	+ 52	0	22.94	—3	
	2		19.8407	19.7203	0	+ .8	— .2	40 36 19.57	+ 3.04	+ 10	+ 10	0	22.81	—4	
	3		11.0717	28.8040	— 5	+ .6	— .9	40 28 54.31	+ 7 27.85	+ 43	— 2	+14	22.71	—4	59.2b
	4		21.1603	17.2820	— 19	— .1	— .3	40 38 0.60	— 1 37.92	+ 2	— 6	— 3	22.61	—4	
	5		11.1793ii	29.4767iv	+ 0	+ .3	+ .9	40 28 39.54	+ 7 42.14	+1.24	+ 16	+13	23.21	—5	58.6
	6		30.3803iv	9.6393ii	0	— .4	— .5	40 27 37.42	+ 8 43.86	+ 1.28	— 13	+14	22.57	—5	58.6
	7		12.2943ii	28.6723iv	— 11	+ 2.2	+ 1.6	40 29 27.77	+ 6 53.64	+ 1.19	+ 55	+ 12	23.27	—6	
July	8		26.9360	12.2847	— 33	+2.4	+1.4	40 42 33.01	— 6 9.96	— 22	+ 56	—10	23.29	—6	58.6
2	X 1	R	27.1200	13.9180	+ 39	+ .9	+ .5	40 41 55.87	— 5 33.52	— 26	+ 20	—10	22.19	+6	73.3
	2		31.4883iv	11.9830ii	— 5	+ .6	+ .3	40 28 8.74	+ 8 12.60	+ 1.36	+ 14	+ 16	23.00	+5	
	3		22.1057	20.0393	+ 13	+ .6	+2.2	40 35 30.62	+ 52.22	+ 11	+ 38	+ 2	23.35	+5	73.1
	4		28.5743iv	13.9883ii	— 41	+1.4	+ 3.0	40 30 12.72	+ 6 8.26	+1.23	+ 60	+10	22.91	+5	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
July								° ′ ″					° ′ ″		
2	X 5	R	10.6040ii	32.1407iv	+ 11	— .1	+ .9	40 45 28.38	— 9 8.94	—1.22	+ 10	—21	40 36 23.11	+4	72.0
	6		19.7380	23.4900	+ 36	+ .9	+1.0	40 34 47.77	+ 1 34.85	+ 16	+ 26	+ 3	23.07	+4	71.3
	7		26.7347	16.2197	+ 91	— .3	—2.1	40 31 57.27	+ 4 25.79	+ 32	— 32	+ 8	23.14	+4	71.2
	8		10.2417	30.8210	+ 64	+ .9	+2.6	40 45 2.71	— 8 39.90	— 43	+ 47	—16	22.69	+3	
	9		12.0870	30.4140	+136	+ .9	+1.8	40 44 6.42	— 7 43.20	— 37	+ 37	—14	23.08	+3	71.4
	10		32.8347iv	7.8677ii	+ 12	+2.1	— .4	40 46 54.59	—10 30.58	—1.35	+ 28	—19	22.75	+3	b
	XI 1		30.4047	14.0477	+215	0	—2.1	40 43 17.62	— 6 53.64	— 29	— 27	—15	23.27	+2	69.6
	2		8.9947ii	33.7710iv	+ 40	— .8	— .6	40 46 50.78	—10 25.83	—1.29	— 20	—24	23.22	+2	68.6
	3		8.9437ii	33.7173iv	+ 38	+2.0	+3.2	40 25 55.51	+10 25.76	+1.46	+ 72	+18	23.63	+2	68.4
	4		7.0167ii	31.6500iv	— 18	+ .6	+ .8	40 26 0.09	+10 22.07	+1.46	+ 20	+18	24.00	+1	69.4
	5		2.4960ii	34.9680iv	— 93	+1.9	+3.2	40 22 41.24	+13 39.85	+1.66	+ 70	+25	23.70	+1	
	6		26.8447	15.4897	+ 79	+ .6	+2.3	40 31 35.20	+ 4 46.97	+ 34	+ 39	+10	23.00	+1	
	7		19.1687	22.9393	+ 23	+ .8	+1.4	40 37 58.11	— 1 35.28	— 3	+ 30	— 3	23.07	0	69.5
	8		22.6033	20.9513	+ 18	+1.1	— .3	40 37 4.51	— 41.76	+ 3	+ 13	— 1	22.90	0	
	I 1		17.8053	24.4633	+ 45	—1.0	—1.9	40 33 35.40	+ 2 48.26	+ 22	— 40	+ 5	23.53	0	68.6
July															
5	I 6	R	21.9923	20.8233	+ 9	+2.0	+1.3	40 35 53.02	+ 29.55	+ 12	+ 48	+ 1	23.18	—2	69.3
	7		11.2987	30.5943	+108	+1.3	+ .3	40 28 14.06	+ 8 7.59	+ 53	+ 24	+15	22.57	—2	
	8		8.1627ii	32.4820iv	+ 9	+1.9	+ .5	40 26 7.55	+10 14.22	+1.45	+ 36	+18	23.76	—2	67.9
	9		15.0097	27.5170	+ 91	+1.2	+1.4	40 31 6.73	+ 5 16.11	+ 36	+ 36	+ 8	23.64	—3	67.7
	10		28.2990	17.5080	+186	— .1	+ .3	40 40 56.54	— 4 33.00	— 13	+ 2	—12	23.31	—3	67.8
	II 1		22.5587	23.0617	+ 8	+ .3	+1.4	40 36 35.83	— 12.73	+ 12	+ 22	0	23.44	—3	
	2		22.8630	22.9290	0	+ .4	+ .4	40 36 20.96	+ 1.67	+ 10	+ 11	0	22.84	—3	67.8
	3		30.2183	12.5317	+142	—1.5	—1.9	40 28 55.58	+ 7 27.05	+ 50	— 47	+14	22.80	—4	67.7b
	4		19.3120	23.2320	+ 31	—1.3	0	40 38 1.78	— 1 39.08	+ 1	— 20	— 3	22.48	—4	67.9
	6		9.5040ii	30.1910iv	0	+1.8	+1.0	40 27 38.68	+ 8 42.46	+1.36	+ 40	+15	23.05	—5	67.4
	7		28.9993iv	12.6640ii	— 20	+1.2	+ .6	40 29 29.00	+ 6 52.50	+1.27	+ 26	+12	23.15	—5	
July	8		15.0347	29.6753	+204	+ .3	+1.9	40 42 34.17	— 6 10.27	— 23	+ 28	—11	23.84	—5	66.9
7	X 1	D	14.1410	27.3387	+ 57	— .9	—2.2	40 41 56.78	— 5 33.44	— 26	— 42	—10	22.56	+6	72.0
	2		9.8157ii	29.3097iv	0	— .4	—1.2	40 28 9.59	+ 8 12.31	+1.36	— 22	+16	23.20	+6	
	3		19.1900	21.2513	+ 3	— .4	—1.5	40 35 31.59	+ 52.07	+ 11	— 25	+ 2	23.54	+6	71.9
	4		12.8797ii	27.4553iv	— 6	+ .1	+ .3	40 30 13.75	+ 6 8.09	+1.23	+ 6	+10	23.23	+6	
	5		30.8040iv	9.2333ii	0	+ .4	0	40 45 29.25	— 9 4.76	—1.21	+ 6	—21	23.13	+5	71.9
	6		22.2947	18.5907	+ 11	+ 3	+1.1	40 34 48.84	+ 1 33.57	+ 16	+ 18	+ 3	23.78	+5	72.0
	7		15.1987	25.6657	+ 28	+ .6	0	40 31 58.47	+ 4 24.41	+ 31	+ 10	+ 8	23.37	+5	
	8		30.1657	9.5700	— 17	0	— .4	40 45 3.90	— 8 40.10	— 41	— 5	—16	23.18	+4	71.9
July															
9	9		29.8167	11.4430	+ 67	+ .1	— .4	40 44 7.65	— 7 44.19	— 37	— 4	—14	22.91	+4	71.9
	X 1	R	27 2673	14.0463	+ 53	+ .5	+ .1	40 41 57.12	— 5 34.03	— 26	+ 9	—10	22.82	+7	71.8
	2		30.3357iv	10.8540ii	0	+ .4	+1.3	40 28 9.92	+ 8 12.01	+1.36	+ 22	+16	23.67	+6	72.4
	3		21.5233	19.4820	+ 5	— .6	—1.8	40 35 31.97	+ 51.57	+ 11	— 32	+ 2	23.35	+6	
	4		28.4437iv	13.8733ii	— 37	—1.8	— .5	40 30 14.16	+ 6 7.89	+1.23	— 34	+10	23.04	+6	
	5		9.3473ii	30.8893iv	0	—1.3	—2.2	40 45 29.61	— 9 4.05	—1.22	— 48	—21	23.65	+5	70.1
	6	D	21.7017	17.9713	— 4	— .7	—1.3	40 34 49.27	+ 1 34.20	+ 16	— 28	+ 3	23.38	+5	69.0
	7		15.3583	25.8387	+ 35	—1.9	—3.7	40 31 58.96	+ 4 24.77	+ 32	— 76	+ 8	23.37	+5	
	8		29.8523	9.2583	— 56	—1.1	—2.0	40 45 4.40	— 8 39.97	— 43	— 42	—16	23.42	+5	
	9		29.2620	10.8830	+ 7	+ .9	+1.1	40 44 8.17	— 7 44.19	— 37	+ 28	—14	23.75	+4	68.8
	10		7.8480ii	32.8757iv	+ 10	+ .2	— .2	40 46 56.49	—10 32.11	—1.35	0	—19	22.84	+4	67.6
	XI 1		11.3877	27.8567	— 35	+ .4	+ .6	40 43 19.37	— 6 55.84	— 29	+ 14	—15	23.23	+3	67.8
	2		31.4710iv	6.5753ii	— 28	+1.1	+1.2	40 46 52.56	—10 28.68	—1.30	+ 32	—24	22.66	+3	67.0
	3		33.2730iv	8.5813ii	+ 28	+1.8	+1.6	40 25 57.60	+10 23.67	+1.46	+ 48	+18	23.39	+3	67.8
	4		32.9073iv	8.4010ii	+ 17	+3.6	+3.4	40 26 2.19	+10 18.95	+1.46	+1.00	+18	23.78	+2	
	5		32.9877iv	0.5640ii	—237	— .6	+ .3	40 22 43.32	+13 38.27	+1.66	— 6	+25	23.44	+2	67.6
	6		14.1247	25.4313	— 17	— .6	—1.0	40 31 37.26	+ 4 45.51	+ 34	— 22	+10	22.99	+2	
	7		22.7420	18.8887	+ 19	+ .5	— .8	40 38 0.32	— 1 37.36	— 3	— 2	— 3	22.88	+1	
	8		19.6200	21.3637	+ 4	—2.0	— .4	40 38 6.66	— 44.05	+ 2	— 36	— 1	22.26	+1	67.6
	I 1		23.4930	16.9770	+ 10	+ .2	+ .2	40 33 37.66	+ 2 44.59	+ 21	+ 6	+ 5	22.57	+1	66.6

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
July 9	I 6	D	19.6533	20.8070	0	— .3	— .3	40 35 54.30	+ 29.14	+ 12	— 8	+ 1	40 36 23.49	—1	65.1
	7		29.5663	10.2850	— 8	—1.6	—1.5	40 28 15.39	+ 8 6.95	+ 53	— 44	+15	22.58	—2	
	8		32.8947iv	8 6827ii	+ 20	+ 3.3	+ 4.0	10 26 8.94	+10 11.56	+ 1.45	+1.02	+18	23.15	—2	64.6
	9		26.9150	14.4367	+ 47	—1.9	—1.5	40 31 8.11	+ 5 15.28	+ 36	— 48	+ 8	23.35	—2	
	10		13.0993	23.9783	— 95	+ .2	0	10 41 57.69	— 4 34.52	— 13	+ 3	—12	22.95	—2	
	II 1		20.3340	19.7817	0	+ .5	0	40 36 36.98	— 13.95	+ 12	+ 8	0	23.23	—2	64.5
	2		20.0617	20.0243	0	— .3	— .7	40 36 22.14	+ 0.94	+ 10	— 14	0	23.04	—3	64.6
	3		10.5347	28.1950	— 67	— .1	—1.1	40 28 56.82	+ 7 25.86	+ 49	— 16	+ 14	23.15	—3	
	4		21.2237	17.2670	— 19	— .7	—2.0	40 38 2.93	— 1 39.89	0	— 36	— 3	22.65	—3	
	5		11.9113	30.1110	+ 109	— .1	— .4	40 28 42.05	+ 7 39.93	+ 50	— 6	+ 13	22.55	—4	63.6
	6		30.0493iv	9.3653ii	0	—2.8	—2.1	40 27 39.88	+ 8 42.40	+1.36	— 70	+15	23.09	—4	
	8		28.0123	13.3577	+ 60	— 0	— .6	40 42 35.28	— 6 11.03	— 28	— 8	—11	23.78	—5	62.8a
July 10	III 1		17.3677	25.1443	+ 57	— .8	— .9	40 39 40.23	— 3 16.55	— 13	— 21	— 5	23.26	—5	63.0
	X 1	R	27.0117	13.7987	+ 31	—1.2	—1.3	40 41 57.26	— 5 33.78	— 26	— 35	—10	22.77	+7	65.8
	2		31.6203iv	12.1177ii	— 5	—2.2	—2.1	40 28 10.06	+ 8 12.55	+1.36	— 61	+16	23.52	+ 6	65.8
	3		23.3857	21.3243	+ 30	—2.0	—1.6	40 35 32.12	+ 52.14	+ 11	— 52	+ 2	23.87	+6	
	4		27.9373iv	13.3770ii	— 23	—3.3	—2.4	40 30 14.34	+ 6 7.68	+ 1.23	— 82	+10	22.53	+ 6	65.1
	5		12.1700ii	31.0323iv	+ 29	—1.0	— .8	40 45 29.76	— 9 4.65	—1.22	— 26	—21	23.42	+5	65.1
	6		19.9010	23.5767	+ 39	+ .7	+ .5	40 34 49.46	+ 1 32.94	+ 16	+ 18	+ 3	22.77	+5	65.0
	7		24.5070	14.0523	— 43	+ .3	— .3	40 31 59.18	+ 4 23.93	+ 31	0	+ 8	23.50	+5	
	8		9.6480	30.2830	— 4	— .1	0	40 45 4.63	— 8 41.15	— 44	— 2	—16	22.86	+5	65.3
	9		9.5783	27.9903	—132	—1.5	— .6	40 44 8.41	— 7 41.69	— 37	— 30	—14	22.91	+5	65.1
	10		32.5916iv	7.5593ii	0	— .8	—1.6	40 46 56.75	—10 32.20	—1.35	— 33	—19	22.68	+ 4	
	XI 1		29.5880	13.1247	+130	+ .1	— .2	40 43 19.62	— 6 56.13	— 30	— 1	—15	23.03	+ 3	64.1
	2		8.8467ii	33.6790iv	+ 37	—1.3	—1.6	40 46 52.82	—10 27.26	—1.30	— 40	—24	23.62	+3	63.4
	3		7.4280ii	32.1093iv	— 8	+1.8	+ 2.1	10 25 57.93	+ 10 23.33	+ 1.46	+ 55	+ 18	23.45	+3	
	4		6.9580ii	31.4873iv	— 20	.2	+1.8	40 26 2.50	+ 10 19.46	+1.46	— 26	+18	23.86	+3	63.5
	5		2.8760ii	35.2710iv	— 67	+ .9	+ .3	40 22 43.63	+ 13 38.01	1.66	+ 18	+25	23.73	+2	
	6		25.2790	13.9863	— 25	—1.8	—1.0	40 31 37.57	+ 4 45.15	+ 34	— 40	+10	22.76	+2	
	7		17.3310	21.2200	— 18	+ .2	+ 1.6	40 38 0.65	— 1 38.18	— 3	+ 24	— 3	22.65	+2	63.1
	8		21.8343	20.0823	+ 10	+1.4	— .2	40 37 7.00	— 44.27	+ 2	+ 19	— 1	22.93	+1	62.9
	I 1		16.3867	22.9130	— 15	+ .2	— .5	40 33 38.00	+ 2 44.79	+ 22	— 4	+ 5	23.02	+1	62.6
	II 1	R	21.6597	22.2307	+ 7	+ .6	+ .4	40 36 37.29	— 14.44	+ 12	+14	0	23.11	—2	59.4
	2		22.3190	22.3663	0	+1.2	— .4	40 36 22.46	+ 0.44	+ 10	+ 14	0	23.14	—3	
	3		29.6337	12.0000	+ 86	—2.1	—2.2	40 28 57.16	+ 7 25.59	+ 49	— 60	+14	22.78	—3	59.6
	4		20.3320	21.2683	+ 51	—1.4	—2.5	40 38 3.25	— 1 39.56	+ 1	— 54	— 3	23.13	—3	
	5		28.6713iv	10.4980ii	+ 3	— .8	+ 1.2	40 28 42.40	+ 7 39.01	+1.31	+ 3	+13	22.88	—4	
	6		9.5130ii	30.1497iv	0	+ .6	+ 1.4	40 27 40.21	+ 8 41.23	+ 1.36	+ 28	+ 15	23.23	—4	58.9
	7		28.3140iv	12.0343ii	— 3	+ .3	+ .1	40 29 30.50	+ 6 51.17	+1.25	+ 6	+ 12	23.10	—4	
	8		12.2887	27.0183	— 31	+ .2	0	40 42 35.60	— 6 11.95	— 28	+ 3	—11	23.29	—5	58.6
	9		22.5473	20.4667	+ 18	— .9	—1.0	40 37 15.87	— 52.59	+ 7	— 26	— 2	23.07	—4	
	III 1		23.8270	16.0307	— 3	+ .7	— .4	40 39 40.53	— 3 16.90	— 13	+ 6	— 5	23.51	—5	
July 11	2		33.1627iv	4.0877ii	— 73	—2.3	—1.7	40 24 7.73	+12 14.15	+1.58	— 57	+23	23.12	—5	57.7
	X 1		13.8533	27.1150	+ 38	+ 2.2	+ 2.2	40 41 57.39	— 5 35.02	— 26	+ 62	—10	22.63	+ 7	70.5
	2		10.7100ii	30.1543iv	0	+ .9	+ .3	40 28 10.17	+ 8 11.07	+ 1.36	+ 18	+ 16	22.91	+ 6	
	3		19.0660	21.0820	0	+ .7	+ .8	40 35 32.26	+ 50.91	+ 11	+ 21	+ 2	23.51	+6	
	4		12.3186ii	26.8707iv	+ 13	+1.3	— .1	40 30 14.49	+ 6 6.80	+1.23	+ 18	+10	22.80	+ 6	
	5		30.4780iv	8.8593ii	0	+ .5	+1.9	40 45 29.89	— 9 5.98	—1.22	+ 32	—21	22.80	+5	70.6
	6		22.0467	18.3390	+ 3	—2.1	—2.4	40 34 49.63	+ 1 33.61	+ 16	— 63	+ 3	22.83	+5	70.1
	7		15.8743	26.2830	+ 67	+ .4	0	40 31 59.39	+ 4 23.01	+ 31	+ 6	+ 8	22.88	+ 5	
	8		30.6780	10.0310	+ 44	+1.6	+ 1.1	40 45 4.84	— 8 41.55	— 44	+ 39	—16	23.08	+5	71.0
	9		29.2130	10.7777	0	+2.4	+ .9	40 44 8.63	— 7 45.58	— 37	+ 48	—14	23.02	+5	
	10		7.2340ii	32.2860iv	— 9	—1.2	— .1	10 46 56.99	—10 32.66	—1.35	— 20	—19	22.59	+4	70.6
	XI 1		12.0873	28.5880	+ 33	+1.3	+ .7	40 43 19.85	— 6 56.81	— 30	+ 29	—15	22.88	+4	
	2		30.4047iv	5.4917ii	— 59	+1.6	+1.2	40 46 53.07	—10 29.03	—1.30	+ 38	—24	22.88	+3	70.4

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
July 16	X 1	R	27.6787	14.4277	+ 83	+ .4	0	40 41 57.86	— 5 34.85	— 26	+ 6	—10	40 36 22.71	+7	77.8
	2		31.8787iv	12.4063ii	— 7	—1.8	—1.5	40 28 10.61	+ 8 11.73	+1.36	— 47	+ 16	23.39	+7	
	3		22.2077	20.2197	+ 14	— .1	+ .1	40 35 32.82	+ 50.24	+ 11	0	+ 2	23.19	+7	
	4		28.1850iv	13.6463ii	— 30	—2.6	—2.8	40 30 15.11	+ 6 7.08	+1.23	— 76	+ 10	22.76	+7	
	5		10.5920ii	32.2093iv	+ 13	0	0	40 45 30.38	— 9 5.95	—1.22	0	—21	23.00	+6	77.8
	6		19.9397	23.6220	+ 39	+ .3	+ .9	40 34 50.31	+ 1 33.09	+ 16	+ 16	+ 3	23.75	+6	
	7		26.7013	16.2867	+ 92	—2.4	—1.6	40 32 0.21	+ 4 23.24	+ 31	— 58	+ 8	23.26	+ 6	77.7
	8		11.0117	31.6497	+ 163	—1.0	—1.2	40 45 5.68	— 8 41.60	— 44	— 31	—16	23.17	+6	
July 17	9		11.4950	29.9030	+ 74	— .5	— .7	40 44 9.51	— 7 45.06	— 37	— 17	—14	23.77	+5	76.0
	X 9	D	29.4583	11.0133	+ 27	—1.1	— .7	40 44 9.71	— 7 45.88	— 37	— 26	—14	23.06	+5	75.0
	10		7.7450ii	32.8463iv	+ 7	— .4	+ .8	40 46 58.22	—10 33.94	—1.35	+ 4	—19	22.78	+ 5	74.4
	XI 1		11.3107	27.8533	— 40	+ .7	+ .8	40 43 20.97	— 6 57.67	— 30	+ 21	—15	23.06	+4	73.4
	2		31.1647iv	6.2357ii	— 39	—1.1	—1.5	40 46 54.24	—10 29.47	—1.30	— 36	—24	22.87	+4	73.1
	3		32.5980iv	7.9413ii	+ 7	—2.7	—5.2	40 25 59.68	+10 22.71	+1.46	—1.08	+ 18	22.95	+4	
	4		32.4567iv	8.0087ii	+ 8	+ .7	+1.0	40 26 4.25	+10 17.44	+1.46	+ 24	+18	23.57	+4	
	5		34.2337iv	1.8913ii	—141	— .3	0	40 22 45.39	+13 36.43	+1.66	— 4	+25	23.69	+ 3	
	6		13.3687	24.6237	— 68	—1.5	—1.4	40 31 39.33	+ 4 44.07	+ 34	— 41	+ 10	23.43	+3	71.4
	7		21.1387	17.1987	— 20	0	+ .3	40 38 2.57	— 1 39.45	— 3	+ 4	— 3	23.10	+3	71.4
	8		19.0943	20.9577	0	+ 2.0	+ 3.6	40 37 8.97	— 47.06	+ 1	+ 77	— 1	22.68	+2	
	I 1		23.9377	17.4937	+ 27	—1.4	—1.3	40 33 40.02	+ 2 42.81	+ 21	— 38	+ 5	22.71	+2	71.2
	II 1	D	20.0883	19.4597	0	— .7	—2.1	40 36 39.17	— 15.88	+ 12	— 38	0	23.03	—2	70.4
	2		19.5030	19.5173	0	—5.2	—5.4	40 36 24.40	— 0.36	+ 10	—1.50	0	22.64	—2	
	3		10.8740	28.4550	— 35	— .4	—2.1	40 28 59.26	+ 7 23.92	+ 49	— 33	+ 14	23.48	—2	70.3
	4		21.4727	17.4160	— 15	+1.3	+ .1	40 38 5.21	— 1 42.41	0	+ 22	— 3	22.99	—2	
	5		11.1807ii	29.2797iv	— 2	+ .2	+ .9	40 28 44.54	+ 7 37.09	+1.30	+ 14	+ 13	23.20	—3	69.8
	6		30.0727iv	9.5100ii	0	— .7	—1.7	40 27 42.34	8 39.32	+1.35	— 32	+ 15	22.84	—3	70.0
	7		11.1977ii	27.3733iv	+ 19	+ 2.0	+1.0	40 29 32.60	+ 6 48.57	+1.25	+ 44	+12	22.98	—4	
	8		26.4617	11.6497	— 84	+1.3	+ .4	40 42 37.60	— 6 13.86	— 28	+ 25	—11	23.60	—4	69.6
	9		18.4757	20.6503	— 5	+ .3	— .8	40 37 17.65	— 54.91	+ 7	— 6	— 2	22.73	—4	
	III 1		16.3170	24.1957	+ 11	0	+1.4	40 39 42.49	— 3 19.00	— 13	+ 18	— 5	23.49	—4	
	2		3.6577ii	32.6450iv	— 99	0	— .4	40 24 9.61	+ 12 11.83	+1.58	— 5	+ 23	23.20	—4	69.4
July 18	3		24.6450	13.9470	— 44	+ .4	0	40 40 53.38	— 4 30.07	— 19	+ 6	— 9	23.09	—4	
	X 1	D	13.3433	26.6150	— 4	+ 1.4	+ 2.2	40 41 58.10	— 5 35.15	— 26	+ 50	—10	23.09	+7	77.0
	2		10.0723ii	29.5023iv	0	+ 1.2	+ .6	40 28 10.84	+ 8 10.69	+1.36	+ 26	+ 16	23.31	+7	
	3		18.2310	20.2230	— 9	+ .1	+ .2	40 35 33.09	+ 50.28	+ 11	+ 4	+ 2	23.54	+7	
	4		13.5567ii	28.0723iv	— 29	—1.2	+1.1	40 30 15.41	+ 6 6.51	+ 1.23	— 4	+ 10	23.21	+7	
	5		30.9617iv	9.3207ii	0	+ .3	— .4	40 45 30.63	— 9 6.53	—1.22	0	—21	22.67	+6	76.9
	6		21.2037	17.5437	— 17	—2.1	—2.0	40 34 50.64	+ 1 32.39	+ 16	— 58	+ 3	22.64	+ 6	77.4
	7		14.8197	25.1927	0	+ .6	— .5	40 32 0.59	+ 4 21.96	+ 31	+ 3	+ 8	22.97	+ 6	75.6
	8		30.0613	9.3547	— 39	+ .8	+ 1.4	40 45 6.06	— 8 42.82	— 44	+ 30	—16	22.94	+ 6	75.1
	9		29.4443	10.9603	+ 19	+ .7	+ .4	40 44 9.91	— 7 46.84	— 37	+ 16	—14	22.72	+6	74.8
	II 3	R	29.0473	11.5020	+ 27	—1.9	—2.5	40 28 59.54	+ 7 23.18	+ 49	— 62	+ 14	22.73	—2	70.5
	4		18.8000	22.8893	+ 21	+ .8	+ .8	40 38 5.46	— 1 43.33	0	+ 22	— 3	22.32	—2	
	5		29.7623iv	11.6830ii	— 8	—1.2	0	40 28 44.81	+ 7 36.58	+1.30	— 18	+ 13	22.64	—3	
	6		10.2233ii	30.7553iv	0	+1.8	+ .5	40 27 42.60	+ 8 38.54	+1.35	+ 34	+ 15	22.98	—3	70.5
	7		28.0950iv	11.9253ii	0	— .4	— .8	40 29 32.86	+ 6 48.37	+1.25	— 16	+ 12	22.44	—4	
	8		13.5963	28.4110	+ 86	— .2	0	40 42 37.85	— 6 14.36	— 28	— 3	—11	23.07	—4	70.5
	9		22.6680	20.4983	+ 20	+1.6	+ 2.0	40 37 17.86	— 54.85	+ 7	+ 50	— 2	23 56	—3	
	III 1		23.2737	15.3780	— 30	+ 1.8	+ .8	40 39 42.74	— 3 19.33	— 13	+ 38	— 5	23.61	—4	69.8
	2		35.0683iv	6.0940ii	+ 31	0	— .5	40 24 9.84	+12 11.83	+1.58	— 6	+ 23	23.42	—4	70.3
	3		13.1503	23.8647	— 96	+ 1.2	+ .6	40 40 53.60	— 4 30.35	— 19	+ 26	— 9	23.23	—4	
July 19	5		22.9390	19.2897	+ 24	+ 1.8	+ .7	40 37 54.90	— 1 32.22	— 2	+ 37	— 3	23.00	—5	70.4
	X 9	R	10.9107	29.3633	+ 13	— .8	—1.4	40 44 10.13	— 7 46.05	— 37	— 30	—14	23.27	+ 6	71.3
	10		32.7253iv	7.6237ii	+ 4	+ .4	+ .2	40 46 58.68	—10 33.95	—1.35	+ 8	—19	23.27	+5	71.0
	XI 1		29.5917	13.0200	+ 127	+ .8	+ 2.2	40 43 21.40	— 6 58.84	— 30	+ 40	—15	22.51	+ 4	71.2

1893	Pair		P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
July 19	XI	2	R	8.6400ii	33.6043iv	+ 33	+1.5	+1.7	° ′ ″ 40 46 54.68	−10 30.56	−1.30	+ 44	−24	° ′ ″ 40 36 23.02	+4	
		3		8.7527ii	33.3073iv	+ 28	+4.5	+3.5	40 26 0.21	+10 20.20	+1.46	+1.14	+18	23.19	4	
		4		8.5790ii	33.0183iv	+ 21	−2.4	−1.7	40 26 4.78	+10 17.27	+1.46	− 59	+18	23.10	+4	
		5		2.2243ii	34.5130iv	−117	+1.7	+2.0	40 22 45.91	+13 35.16	+1.66	+ 52	+25	23.50	+3	70.6
		6		26.9257	15.7300	+ 88	−2.5	− .5	40 31 39.85	+ 4 42.97	+ 34	− 45	+10	22.81	+3	
		7		18.6720	22.6233	+ 16	−1.7	− .6	40 38 3.14	− 1 39.83	− 3	− 34	− 3	22.91	+3	69.5
		8		23.6360	21.7863	+ 30	+ .2	− .8	40 37 9.54	− 46.79	+ 1	− 7	− 1	22.68	+3	68.4
	I	1		17.0553	23.4727	+ 11	+ .2	+ .3	40 33 40.61	+ 2 42.10	+ 21	+ 7	+ 5	23.04	+2	67.9
	II	1	D	19.8870	19.2473	− 3	−2.6	−2.1	40 36 39.66	− 16.15	+ 12	− 68	0	22.95	−1	
		2		18.4487	18.4887	0	−1.1	−1.2	40 36 24.91	− 1.01	+ 10	− 32	0	23.68	−2	65.0
		3		10.5123	28.0253	− 76	+ .5	− .3	40 28 59.81	+ 7 22.12	+ 49	+ 4	+14	22.60	−2	
		4		21.1007	17.0170	− 23	+ .7	− .9	40 38 5.71	− 1 43.08	0	0	− 3	22.60	−2	64.1
		5		11.2143ii	29.2880iv	− 3	+ .1	− .1	40 28 45.09	+ 7 36.47	+1.30	0	+13	22.99	−3	
		6		30.8417iv	10.2777ii	0	−2.7	−2.2	40 27 42.88	+ 8 39.37	+1.35	− 70	+15	23.05	−3	64.4
		7		12.6950ii	28.8687iv	− 18	+ .2	+ .2	40 29 33.14	+ 6 48.45	+1.25	+ 6	+12	23.02	−3	63.5
		8		27.4110	12.5830	0	+1.7	+1.4	40 42 38.11	− 6 14.50	− 29	+ 44	−11	23.65	−3	
		9		18.1830	20.3647	− 9	−1.3	−2.2	40 37 18 09	− 55 08	+ 7	− 48	− 2	22.58	−3	61.9
	III	1		16.4080	24.2830	+ 14	−2.1	−1.2	40 39 42.98	− 3 18.93	− 13	− 48	− 5	23.39	−4	
		2		3.8383ii	32.8137iv	− 88	+ .1	− .6	40 24 10.08	+12 11.59	+1.58	− 6	+23	23.42	−4	61.7
		4		25.7973	14.5017	+ 9	− .7	−1.0	40 41 9.59	− 4 45.31	− 21	− 24	− 8	23.75	−5	61.2
July 20	X	5		17.2027	20.8227	− 21	−1.4	−1.8	40 37 55.09	− 1 31.38	− 2	− 44	− 3	23.22	−4	*d*
		3	R	21.5847	19.5897	+ 6	− .5	−1.5	40 35 33.41	+ 50.40	+ 11	− 27	+ 2	23.67	+7	71.2
		4		28.5353iv	14.0330ii	− 43	− .6	− .8	40 30 15.76	+ 6 6.16	+1.23	− 20	+10	23.05	+7	
		5		10.4283ii	32.0523iv	+ 12	−2.0	− .2	40 45 30.93	− 9 6.15	−1.22	− 34	−21	23.01	+6	71.2
		6		19.4043	23.0377	+ 25	+1.0	+ .9	40 34 51.01	+ 1 31.57	+ 16	+ 27	+ 3	23.04	+6	70.4
		7		25.6817	15.2903	+ 31	−2.1	−3.3	40 32 1.00	+ 4 22.51	+ 31	− 74	+ 8	23.16	6	
		9		28.6180	10.1297	− 68	+ .5	− .2	40 44 10.36	− 7 46.76	− 37	+ 6	−14	23.15	+6	69.9
		10		7.5440ii	32.6557iv	+ 3	− .9	− .6	40 46 58.93	−10 34.21	−1.35	− 22	−18	22.97	+6	70.0
	XI	1		10.5540	27.1370	−112	+1.6	+ .4	40 43 21.64	− 6 58.53	− 30	+ 30	−15	22.96	+5	69.6
		2		31.7517iv	6.7900ii	− 21	+ .2	+ .6	40 46 54.92	−10 30.36	−1.30	+ 10	−24	23.12	+4	
		3		32.3290iv	7.7050ii	0	−1.8	−2.6	40 26 0.49	+10 21.88	+1.46	− 61	+18	23.40	+4	68.9
		4		32.2417iv	7.8020ii	0	− .2	− .5	40 26 5.06	+10 17.23	+1.46	− 10	+18	23.83	+4	68.1
		5		33.5600iv	1.2473ii	−187	−1.6	− .1	40 22 46.17	+13 35.60	+1.66	− 26	+25	23.42	+4	
		6		13.1443	24.3267	− 83	+ .8	+1.0	40 31 40.14	+ 4 42.20	+ 34	+ 25	+10	23.03	+3	68.1
		7		21.7900	17.7950	− 5	+1.3	+1.0	40 38 3.44	− 1 40.88	− 4	+ 32	− 3	22.81	+3	
		8		18.2373	20.0717	− 12	−1.7	−2.2	40 37 9.86	− 46.30	+ 2	− 54	− 1	23.03	+3	67.9
July 23		9		22.3177	15.8837	− 36	− .6	−1.3	40 33 40.93	+ 2 42.40	+ 21	− 26	+ 5	23.33	2	66.6
	II	1	R	20.3730	21.0930	+ 8	+3.2	+1.5	40 36 40.82	− 18.19	+ 11	+ 68	0	23.42	−1	62.9
		2		20.9173	20.8097	0	+2.2	+ .1	40 36 26.10	− 2.72	+ 10	+ 36	0	23.84	−1	63.0
		3		29.3800	11.9387	+ 68	+2.3	+1.2	40 29 1.08	+ 7 20.68	+ 49	+ 51	+14	22.90	−2	
		4		19.1707	23.2750	+ 30	−2.0	− .4	40 38 6.90	− 1 43.74	0	− 36	− 3	22.77	−2	
		5		29.3737iv	11.3717ii	− 5	+ .6	+ .3	40 28 46.37	+ 7 34.66	+1.26	+ 14	+13	22.56	−2	60.9
		6		10.1530ii	30.6240iv	0	+ .6	− .1	40 27 44.15	+ 8 37.03	+1.31	+ 8	+15	22.72	−3	
		7		28.6303iv	12.5073ii	− 15	−1.0	−1.5	40 29 34.38	+ 6 47.17	+1.21	− 34	+12	22.54	−3	61.1
		8		12.9097	27.7463	+ 28	−1.0	−1.0	40 42 39.29	− 6 14.80	− 28	− 28	−11	23.82	−3	
		9		22.4530	20.2540	+ 18	−1.5	− .8	40 37 19.13	− 55.58	+ 7	− 33	− 2	23.27	−3	60.4
	III	1		24.3160	16.3743	+ 16	+ .7	+ .4	40 39 44.12	− 3 20.63	− 13	+ 16	− 5	23.47	−4	59.9
		2		34.3480iv	5.4237ii	− 8	−2.5	− .7	40 24 11.16	+12 10.52	+1.54	− 48	+23	22.97	−4	
		3		13.6327	24.3943	− 63	−1.8	−1.6	40 40 54.87	− 4 31.65	− 19	− 48	− 9	22.46	−4	
		4		13.7677	25.1257	− 38	− .7	+ .5	40 41 10.60	− 4 46.77	− 21	− 4	− 8	23.50	−4	59.2
		5		24.3560	20.6750	+ 56	+1.8	+2.5	40 37 55.99	− 1 33.11	− 2	+ 60	− 3	23.43	−4	
		6		15.5243	29.3150	+197	− .8	−1.0	40 42 13.11	− 5 48.81	− 20	− 25	−14	23.71	−4	58.8
July 27		7		23.6747	18.0777	+ 31	+ .6	− .1	40 38 44.67	− 2 21.44	− 7	+ 8	− 4	23.20	−5	58.1
	XI	1	R	29.9867	13.3900	+167	− .6	− .1	40 43 23.04	− 6 59.59	− 38	− 11	−15	22.81	+5	67.6
		2		9.2897ii	34.3117iv	+ 53	+ .8	0	40 46 56.41	−10 32.09	−1.33	+ 12	−24	22.87	+5	66.7

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
July 27	XI 8	R	8.0207ii	32.5150iv	+ 8	+2.4	+1.4	° ′ ″ 40 26 2.31	+10 18.65	+1.51	+ 55	+18	° ′ ″ 40 36 23.20	+5	
	4		8.1707ii	32.5137iv	+ 10	— .1	—1.0	40 26 6.88	+10 14.83	+1.50	— 14	+18	23.25	+5	66.3*d*
	5		2.1437ii	34.3507iv	—126	+1.5	— .6	40 22 48 02	+13 33.11	+1.73	+ 16	+25	23.27	+5	65.8
	6		25.7623	14.6477	+ 14	—2.0	—1.5	40 31 41.98	+ 4 40.75	+ 39	— 50	+10	22.72	+4	64.2
	7		17.9590	22.0057	0	—1.2	—2.0	40 38 5.47	— 1 42.21	— 6	— 44	— 3	22.73	+4	
	8		22.1033	20.1620	+ 12	—1.0	—1.5	40 37 11.93	— 49.06	+ 1	— 34	— 1	22.53	+4	64.0
	I 1		17.7010	24.0183	+ 30	— .9	—1.2	40 33 43.07	+ 2 39.63	+ 24	— 30	+ 5	22.69	+3	63.4
	2		13.1350	27.1493	+ 11	0	0	40 42 17.55	— 5 53.97	— 34	0	—10	23.14	+2	62.6
	3		17.6943	23.2100	+ 16	— .2	— .4	40 34 3.72	+ 2 19.35	+ 22	— 8	+ 3	23.24	+3	62.1
	4		23.7980	19.9707	+ 43	+ .2	— .4	40 34 46.26	+ 1 36.78	+ 17	— 2	+ 3	23.22	+2	
	5		23.5947	18.5147	+ 32	+ .4	+ .1	40 34 14.59	+ 2 8.38	+ 20	+ 8	+ 3	23.28	+2	62.5
	6		21.1357	20.2353	+ 3	— .1	+ .5	40 35 59.53	+ 22.75	+ 12	+ 5	+ 1	22.46	+1	
	7		11.6617	30.6997	+133	— .5	— .4	40 28 20.96	+ 8 1.16	+ 61	— 13	+15	22.75	+1	
	8		8.4913ii	32 5283iv	+ 12	+ .8	—1.2	40 26 14.82	+10 7.12	+1.49	— 3	+17	23.57	+1	62.3
	9		14.5127	26.7410	+ 44	+1.1	— .6	40 31 14.04	+ 5 8.95	+ 41	+ 10	+ 8	23.58	+1	62.4
July 29	10		28.1567	17.1467	+171	— .8	—2.0	40 41 2.63	— 4 38.50	— 18	— 38	—11	23.46	0	61.0
	XI 1	D	11.9133	28.5593	+ 24	+ .7	+ .7	40 43 23.34	— 7 0.44	— 37	+ 20	—15	22.58	+6	75.5
	2		31.5050iv	6.4507ii	— 31	+1.6	+1.6	40 46 56.71	—10 32.66	—1.34	+ 46	—24	22.93	+5	75.5
	3		32.5757iv	8.0780ii	+ 11	—1.0	— .2	40 26 2.70	+10 18.70	+1.50	— 18	+18	22.90	+5	
	4		32.5053iv	8.1603ii	+ 10	— .6	— .3	40 26 7.28	+10 14.84	+1.49	— 14	+18	23.65	+5	
	5		33.5730iv	1.3340ii	—181	—2.3	—1.3	40 22 48.43	+13 33.72	+1.73	— 52	+25	23.61	+5	74.6
	6		14.0610	25.1577	— 26	+ .2	— .1	40 31 42.40	+ 4 40.17	+ 39	+ 2	+10	23.08	+4	
	7		22.5230	18.4567	+ 14	+ .3	— .3	40 38 5.93	— 1 42.73	— 6	0	— 3	23.11	+4	72.9
	8		19.9770	21.9330	+ 11	— .4	—2.6	40 37 12.41	— 49.43	+ 1	— 39	— 1	22.59	+4	72.8*d*
	I 1		23.4787	17.1610	+ 13	—1.2	+ .5	40 33 43.56	+ 2 39.59	+ 24	— 12	+ 5	23.32	+4	
	2		27.6990	13.6757	+ 56	—1.9	—3.1	40 42 18.05	— 5 54.30	— 34	— 69	—10	22.62	+3	71.1
	3		24.3733	18.8737	+ 56	— .8	—1.0	40 34 4.25	+ 2 19.03	+ 22	— 25	+ 3	23.28	+3	71.5
	4		18.9710	22.7753	+ 21	+ .1	— .2	40 34 46.80	+ 1 36.13	+ 17	— 1	+ 3	23.12	+3	71.1
	5		18.1367	23.1967	+ 20	+1.6	+1.3	40 34 15.15	+ 2 7.83	+ 20	+ 42	+ 3	23.63	+2	71.5
	6		19.2763	20.2073	0	— .7	—1.8	40 36 0.03	+ 23.52	+ 12	— 34	+ 1	23.34	+2	
	7		29.6537	10.6073	+ 15	—1.5	—2.4	40 28 21.49	+ 8 1.04	+ 12	— 54	+15	22.26	+1	
	8		33.4680iv	9.4613ii	+ 35	—1.1	— .5	40 26 15.40	+10 6.37	+1.49	— 24	+17	23.19	+1	
	9		27.1577	14.9573	+ 77	— .3	— .6	40 31 14.45	+ 5 8.31	+ 41	— 12	+ 8	23.13	+1	
July 30	10		14.2860	25.3617	— 13	—1.2	— .2	40 41 3.12	— 4 39.68	— 19	— 21	—11	22.93	0	71.0
	XI 1	R	29.1750	12.5573	+ 84	—1.0	— .9	40 43 23.47	— 6 59.89	+ 5	— 27	—15	23.21	+6	71.0
	2		8.6480ii	33.6710iv	+ 35	+ .2	— .8	40 46 56.87	—10 32.04	—1.34	— 7	—24	23.18	+5	70.6
	3		8.5100ii	32.9927iv	+ 20	+1.6	+2.3	40 26 2.91	+10 18.37	+1.50	+ 54	+18	23.50	+6	70.2
	4		8.1683ii	32.5057iv	+ 10	+ .9	— .2	40 26 7.48	+10 14.67	+1.49	+ 12	+18	23.94	+5	
	5		1.7590ii	33.9643iv	—154	— .4	—1.4	40 22 48.63	+13 32.96	+1.73	— 24	+25	23.33	+5	*d*
	6		26.1783	15.1010	+ 42	+ .8	— .6	40 31 42.60	+ 4 39.87	+ 39	+ 5	+10	23.01	+5	70.6
	7		19.5633	23.6267	+ 37	—1.4	— .9	40 38 6.16	— 1 42.71	— 6	— 33	— 3	23.03	+4	69.8*d*
	8		20.8550	18 8763	0	+ .1	— .3	40 37 12.65	— 49.97	0	— 2	— 1	22.65	+4	69.4
	I 1		18.1877	24.4820	+ 51	— .5	—1.1	40 33 43.81	+ 2 39.09	+ 24	— 22	+ 5	22.97	+4	
	3		18.1167	23.5973	+ 28	+ .7	— .1	40 34 4.51	+ 2 18.48	+ 22	+ 10	+ 3	23.34	+3	69.3
	4		23.7523	19.9503	+ 42	—1.5	—1.7	40 34 47.06	+ 1 36.12	+ 17	— 44	+ 3	22.94	+3	69.2
	5		22.5670	17.5067	0	—1.3	—1.2	40 34 15.41	+ 2 7.80	+ 20	— 36	+ 3	23.08	+2	68.4
	6		22.4543	21.5477	+ 13	— .8	— .4	40 36 0.27	+ 22.93	+ 12	— 18	+ 1	23.15	+2	
	7		11.1753	30.1920	+ 75	—1.9	—1.1	40 28 21.76	+ 8 0.46	+ 61	— 44	+15	22.54	+1	
	8		9.1843ii	33.1753iv	+ 28	+ .8	0	40 26 15.68	+10 5.97	+1.49	+ 12	+17	23.43	+1	69.0
	9		14.7110	26.8687	+ 57	+1.9	+ .5	40 31 14.91	+ 5 7.18	+ 41	+ 36	+ 8	22.94	+1	
Aug. 2	10		28.0510	17.0187	+165	+ .3	— .8	40 41 3.35	— 4 39.04	— 19	— 6	—11	23.95	0	68.4
	III 1	D	16.5610	24.6060	+ 29	— .4	— .9	40 39 47.02	— 3 23.26	— 17	— 18	— 5	23.36	—2	64.0
	2		5.4570ii	34.2923iv	— 6	—1.2	—2.9	40 24 13.97	+12 8.26	+1.63	— 56	+23	23.53	—3	63.9
	4		26.3873	14.9267	+ 44	—1.5	—2.5	40 41 13.31	— 4 49.56	— 27	— 55	— 8	22.85	—3	63.6*a*
	5		18.4930	22.2560	+ 10	—1.6	—1.1	40 37 58.45	— 1 35.07	— 4	— 39	— 3	22.92	—3	63.6

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections	Corrections: l	Corrections: r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Aug. 2	III 6	D	26.5543	12.6377	— 34	+1.6	+1.3	40 42 15.31	— 5 51.39	— 27	+ 42	—14	40 36 23.93	—3	
	7		17.8777	23.5437	+ 24	—1.8	—1.2	40 38 47.05	— 2 23.16	— 10	— 44	— 4	23.31	—4	63.9
	8		25.8680	15.4217	+ 39	— .2	— .6	40 40 47.75	— 4 23.93	— 22	— 10	— 9	23.41	—4	
Aug. 5	10		9.9197ii	31.6797iv	+ 9	— .4	— .2	40 27 12.82	+ 9 9.59	+1.41	— 8	+15	23.89	—4	63.0
	XI 1	D	11.4640	28.1570	— 17	+2.0	+1.5	40 43 21.55	— 7 1.53	— 38	+ 50	—15	22.99	+6	77.2
	2		31.3603iv	6.2827ii	— 35	— .7	— .6	40 46 58.03	—10 33.22	—1.35	— 18	—24	23.04	+6	76.7
	3		32.4107iv	7.9827ii	+ 7	— .2	+ .3	40 26 4.32	+10 16.93	+1.50	+ 1	+18	22.94	+ 6	
	4		32.1407iv	7.8817ii	0	+ 1.2	+1.2	40 26 8.90	+ 10 12.65	+1.49	+ 34	+ 18	23.56	+6	
	5		33.7320iv	1.5953ii	—170	+ 1.2	+ .9	40 22 50.06	+ 13 31.15	+1.73	+ 30	+ 25	23.49	+6	76.6
	6		13.6207	24.6150	— 56	+1.1	+ .6	40 31 44.04	+ 4 38.27	+ 39	+ 24	+10	23.04	+5	76.4
	7		22.3360	18.2000	+ 8	— .8	—1.4	40 38 7.74	— 1 44.47	— 6	— 30	— 3	22.88	+5	76.1
	8		19.1957	21.2237	0	+ .2	+ .1	40 37 14.28	— 51.22	0	+ 4	— 1	23.09	+5	75.6
	I 1		23.0753	16.8753	— 0	+ .4	+1.1	40 33 45.49	+ 2 36.58	+ 24	+ 20	+ 5	22.56	+5	
	2		26.4900	12.3757	— 48	+ .7	— .5	40 42 20.01	— 5 56.32	— 34	+ 4	—10	23.29	+4	74.4
	4		23.0873	17.6680	+ 13	—2.0	—2.2	40 34 6.27	+ 2 16.89	+ 22	— 59	+ 3	22.82	+4	
	5		17.3923	22.3500	— 3	+ .6	0	40 31 17.24	+ 2 5.19	+ 20	+ 10	+ 3	22.76	+ 3	72.5
	6		19.1853	20.0000	— 3	+1.0	+ .6	40 36 1.93	+ 20.57	+ 11	+ 23	+ 1	22.85	+3	72.2
	7		29.5510	10.5887	+ 6	— .3	+ .1	40 28 23.55	+ 7 58.90	+ 61	— 3	+15	23.18	+2	
	8		32.0613iv	8.1520ii	+ 3	—1.0	+ .1	40 26 17.57	+10 3.82	+1.48	— 14	+17	22.90	+2	
	9		26.7967	14.7027	+ 54	0	— .1	40 31 16.82	+ 5 5.56	+ 41	— 2	+ 8	22.85	+ 2	71.9
	III 1	R	24.5013	16.4200	+ 21	—1.0	— .7	40 39 47.95	— 3 24.14	— 17	— 24	— 5	23.35	—2	69.9
	2		35.0167iv	6.2680ii	+ 32	—1.5	—1.9	40 24 14.89	+ 12 6.89	+1.63	— 47	+23	23.17	—2	69.9
	3		16.4270	27.2917	+120	—1.7	— .4	40 40 58.45	— 4 34.69	— 24	— 32	— 9	23.11	—2	70.0
	4		14.7147	26.2340	+ 31	+ .7	+ .8	40 41 14.16	— 4 51.00	— 27	+ 21	— 8	23.02	—3	
	6		13.6893	27.6243	+ 56	+ .3	+ .1	40 42 15.98	— 5 52.08	— 27	+ 6	—14	23.55	—3	69.6
	7		24.4313	18.7233	+ 53	+ .9	— .4	40 38 47.75	— 2 24.29	— 10	+ 9	— 4	23.41	—4	69.4
	8		16.4057	26.8343	+ 100	—1.9	—3.0	40 40 48.41	— 4 23.63	— 22	— 68	— 9	23.79	—4	69.1
	9		27.6457	15.9653	+ 128	— .7	— .5	40 31 27.98	+ 4 55.32	+ 43	— 18	+ 11	23.66	—3	
Aug. 6	10		31.4237iv	9.7290ii	+ 5	+2.4	+3.0	40 27 13.45	+ 9 7.91	+ 1.41	+ 75	+15	23.67	—4	69.5
	III 1	D	16.5560	24.6643	+ 29	+ .7	0	40 39 48.29	— 3 24.86	— 17	+ 11	— 5	23.32	—2	62.1
	2		5.3777ii	34.1657iv	— 10	—1.4	—2.7	40 24 15.19	+ 12 7.06	+1.63	— 56	+23	23.55	—2	
	3		24.8723	13.9550	— 36	+1.3	+ .6	40 40 58.27	— 4 35.65	— 21	+ 28	— 9	22.57	—2	62.4
	4		25.3673	13.8560	— 26	+ .8	—2.2	40 41 14.48	— 4 50.67	— 27	— 16	— 8	23.30	—3	
	5		18.1613	21.9530	0	—1.6	—2.0	40 37 59.51	— 1 35.77	— 4	— 50	— 3	23.17	—3	61.8
	6		25.2737	11.3160	—141	+ .2	— .9	40 42 16.25	— 5 52.17	— 27	— 8	—14	23.59	—3	61.6
	7		17.9700	23.6877	+ 31	—1.4	+ .3	40 38 48.05	— 2 24.49	— 10	— 18	— 4	23.24	—4	61.8
	8		24.0140	13.5720	— 75	— .7	—1.4	40 40 48.63	— 4 24.30	— 22	— 29	— 9	23.73	—3	
	9		13.0977	24.7897	— 72	—1.6	—1.6	40 31 28.21	+ 4 55.11	+ 43	— 46	+11	23.40	—3	
Aug. 7	10		9.5247ii	31.2427iv	+ 2	— .5	— .5	40 27 13.69	+ 9 8.53	+ 1.41	— 14	+15	23.64	—4	60.6
	XI 1	R	30.3157	13.6410	+194	+ .5	+ .6	10 43 24.88	— 7 1.61	— 38	+ 16	—15	22.90	+6	71.3
	2		8.8623ii	33.9490iv	+ 42	+ .2	— .4	40 46 58.38	—10 33 67	—1.35	— 2	—24	23.10	+ 6	69.8
	III 1	R	24.4190	16.3060	+ 17	—1.2	— .3	40 39 48.64	— 3 24.94	— 17	— 22	— 5	23.26	—2	65.6
	2		34.9620iv	6.2383ii	+ 31	— .2	— .5	10 24 15.52	+ 12 5.52	+1.63	— 10	+23	22.80	—2	
	3		14.2487	25.1440	— 22	— .9	— .6	40 40 59.09	— 4 35.12	— 24	— 22	— 9	23.42	—2	
	4		15.4563	26.9807	+ 84	—1.4	— .7	40 41 14.81	— 4 51.27	— 27	— 30	— 8	22.89	—3	65.9*a*
	5		23.6463	19.8433	+ 39	+1.0	+ .6	40 37 59.80	— 1 36.14	— 4	+ 23	— 3	23.82	—3	65.5
	6		14.6823	28.6247	+136	— .4	—1.5	40 42 16.51	— 5 52.46	— 27	— 25	—14	23.39	—3	65.4
	7		24.5287	18.7793	+ 60	+1.8	+ .9	40 38 48.34	— 2 25.36	— 10	+ 40	— 4	23.24	—3	65.2
	8		17.1127	27.5743	+147	— .9	— .9	40 40 48.89	— 4 24.59	— 22	— 26	— 9	23.73	—3	65.1
	9		27.4977	15.8487	+114	—1.3	—1.0	40 31 28.45	+ 4 54.49	+ 43	— 32	+11	23.16	—3	
Aug. 8	10		31.6247iv	9.9330ii	+ 8	+ .8	— .3	40 27 13.95	+ 9 7.86	+ 1.41	+ 8	+15	23.45	—4	65.1
	XI 1	R	30.7933	14.1450	+243	— .1	— .6	40 43 25.11	— 7 1 06	— 37	— 9	—15	23.44	+ 7	72.9
	2		9.5110ii	34.5940iv	+ 61	— .5	— .6	40 46 58.56	—10 33.62	—1.35	— 16	—24	23.19	+ 6	72.6
	3		8.1010ii	32.4773iv	+ 9	+ 1.8	+ 1.6	40 26 4.99	+10 15.64	+1.50	+ 48	+18	22.79	+7	
	4		9.0567ii	33.2963iv	+ 30	— .1	— .1	40 26 9.57	+10 12.24	+1.49	— 3	+18	23.45	+6	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Aug. 8	XI 5	R	2.8063ii	34.9377iv	— 82	—1.2	—1.6	40 22 50.75	+13 31.27	+1.73	— 39	+25	40 36 23.61	6	72 6
	6		26.6167	15.6267	+ 72	—1.0	— .2	40 31 44.75	+ 4 37.74	+ 38	— 18	10	22.79	6	
	7		17.7910	21.9467	— 4	— .9	— .2	40 38 8.53	— 1 44.94	— 6	— 16	— 3	23.34	8	72.1
	8		21.3000	19.2400	+ 3	— .3	— .9	40 37 15.10	— 52.03	0	— 16	— 1	22.90	5	
	I 1		17.3513	23.5473	+ 17	— .3	— .3	40 33 46.36	+ 2 36.52	+ 24	— 8	+ 5	23.09	5	71.9
	2		13.0433	27.1773	+ 10	—1.8	—1.5	40 42 20.89	— 5 56.98	— 34	— 47	—10	23.00	5	71.1
	3		16.4687	21.8540	— 27	.5	— .7	40 34 7.18	+ 2 15.93	+ 21	— 1	+ 3	23.34	4	71.1
	4		23.1763	19.4793	+ 29	— .2	—1.0	40 34 49.81	+ 1 33.44	+ 17	— 16	+ 3	23.29	4	
	5		23.5447	18.6007	+ 33	—1.1	— .2	40 34 18.22	+ 2 4.96	+ 20	— 20	+ 3	23.21	4	70.6
	6		22.4283	21.6233	+ 11	— .5	+ .4	40 36 2.83	+ 20.36	+ 11	— 3	+ 1	23.28	3	
	7		12.0313	30.9313	+165	— .8	— .8	40 28 24.51	+ 7 57.74	+ 61	— 22	+15	22.79	3	
	8		8.7127ii	32.6060iv	+ 18	+ .3	— .1	40 26 18.62	+ 10 3.47	+1.48	+ 3	+ 17	23.77	3	
	9		15.1763	27.2170	+ 81	+ .4	+ .5	40 31 17.86	+ 5 4.30	+ 40	+ 12	+ 8	22.76	2	70.4
	10		27.9623	16.8037	+ 156	+ .3	—1.0	40 41 5.84	— 4 42.21	— 19	— 8	—11	23.25	+1	70.6
	III 1	D	16.3133	21.4560	+ 20	+ .1	0	40 39 48.97	— 3 25.70	— 17	+ 2	— 5	23.07	—2	67.6
	2		5.2177ii	33.9693iv	— 22	.8	— .9	40 24 15.87	+12 6.09	+ 1.63	+ 1	+ 23	23.83	—2	
	3		24.9210	13.9800	— 35	— .1	— .4	40 40 59.42	— 4 36.24	— 24	— 6	— 9	22.79	—2	67.6
	4		26.1847	14.6630	+ 29	+ .4	—1.0	40 41 15.14	— 4 51.06	— 27	— 6	— 8	23.67	—2	*a*
	5		18.1897	22.0260	0	0	— .2	40 38 0.11	— 1 36.88	— 4	— 2	— 3	23.14	—3	67.1
	6		26.6877	12.7113	— 21	— .6	—1.0	40 42 16.79	— 5 52.92	— 27	— 22	—14	23.24	—3	66.9
	7		18 4830	24.2207	+ 48	—1.1	—1.7	40 38 48.64	— 2 25.03	— 10	— 38	— 4	23.09	—3	
	8		25.2720	14.7677	0	— .8	—2.4	40 40 49.16	— 4 25.30	— 22	— 43	— 9	23.12	—3	66.4
	9		13.9823	25.6340	— 10	—1.6	—1.4	40 31 28.70	+ 4 54.24	+ 43	— 43	+ 11	23.05	—3	
Aug. 9	10		8.6403ii	30.3320iv	— 5	— .8	— .3	40 27 14.21	+ 9 7.82	+ 1.41	— 16	+ 15	23.43	—4	66.4
	XI 1	D	10.7347	27.4667	— 90	+ 2.2	+2.3	40 43 25.15	— 7 2.32	— 38	+ 64	—15	22.94	+7	80.4
	2		30.8187iv	5.6843ii	— 52	+ 2.0	+ .7	40 46 58.70	—10 31.61	—1.35	+ 40	—24	22.90	+ 6	79.9
	3		34.0090iv	9.6100ii	+ 45	— .9	— .4	40 26 5.17	+ 10 16.28	+1.50	— 19	+18	22.94	+7	
	4		32.7307iv	8.4927ii	+ 15	— .5	+1.1	40 26 9.77	+10 12.13	+1.49	+ 6	+ 18	23.63	+6	
	5		33.1857iv	1.0607ii	—204	— .5	—1.1	40 22 50.95	+ 13 30.75	+ 1.73	— 22	+ 25	23.46	+ 6	79.0
	6		15.1957	26.1707	+ 44	+ .1	— .1	40 31 44.94	+ 4 37.27	+ 38	0	+ 10	22.69	+ 6	
	7		22.8833	18.6937	+ 20	+ .3	+ .3	40 38 8.75	— 1 45.85	— 6	+ 8	— 3	22.89	+ 8	78.8
	8		19.1467	21.2113	0	0	— .8	40 37 15.33	— 52.14	0	— 10	— 1	23.08	+ 5	77.9
	I 1		24.1800	18.0070	+ 41	— .4	+ .5	40 33 46.61	+ 2 35.99	+ 21	0	+ 5	22.89	+ 5	77.5
	2		27.5303	13.3793	+ 40	— .3	—1.2	40 42 21.15	— 5 57.46	— 34	— 20	—10	23.05	+5	
	3		23.5290	18.1490	+ 27	— .9	—1.3	40 34 7.46	+ 2 15.94	+ 21	— 30	+ 3	23.34	+ 4	76.9
	4		18.2177	21.9057	0	— .1	— .6	40 34 50.09	+ 1 33.14	+ 17	— 9	+ 3	23.34	+ 4	
	5		18.1157	23.0477	+ 17	+ .2	— .2	40 34 18.51	+ 2 4.59	+ 20	0	+ 3	23.33	+ 4	75.9
	6		19.2183	19.9983	— 3	+ .1	+ .8	40 36 3.11	+ 19.69	+ 11	+ 12	+ 1	23.01	+3	
	7		30.2130	11.3543	+ 89	—1.6	—3.4	40 28 24.81	+ 7 57.23	+ 61	— 68	+ 15	22.12	+ 3	
	8		32.5127iv	8.6520ii	+ 14	+ .3	+ .1	40 26 18.91	+ 10 2.60	+ 1.48	+ 6	+ 17	23.22	+ 3	
	9		26.7673	14.7080	+ 53	—1.0	—1.0	40 31 18.19	+ 5 4.68	+ 41	— 28	+ 8	23.08	+ 2	
	10		13.7227	24.9113	— 45	+ .6	+ .8	40 41 6.12	— 4 43.19	— 19	+ 20	—11	22.83	+ 2	75.2
	III 1	R	24.8070	16.6687	+ 35	—1.3	— .8	40 39 49.32	— 3 25.62	— 17	— 30	— 5	23.18	—2	69.4
	2		34.1380iv	5.4377ii	— 12	— .1	+ .5	40 24 16.10	+ 12 4.80	+ 1.63	+ 5	+ 23	22.81	—2	
	3		15.8340	26.7597	+ 84	— .6	+ .1	40 40 59.74	— 4 36.14	— 24	— 8	— 9	23.19	—2	70.5
	4		14.4440	25.9870	+ 13	—1.4	— .7	40 41 15.46	— 4 51.56	— 27	— 30	— 8	23.25	—2	69.9
	5		24.2580	20.4380	+ 54	— .1	— .4	40 38 0.40	— 1 36.61	— 4	— 6	— 3	23.66	—3	69.4
	6		14.4603	28.4113	+119	— .8	— .6	40 42 17.06	— 5 52.64	— 27	— 20	—13	23.82	—2	
	7		24.0773	18.3233	+ 41	— .3	— .5	40 38 48.93	— 2 25.42	— 10	— 11	— 4	23.26	—3	69.1
	8		16.7143	27.1973	+ 122	—1.0	— .4	40 40 49.43	— 4 25.06	— 23	— 20	— 9	23.85	—3	
	9		28.0047	16.3703	+149	—2.4	—2.3	40 31 28.96	+ 4 54.21	+ 43	— 66	+11	23.05	—3	*a*
Aug. 10	10		31.3503iv	9.6780ii	+ 6	— .6	—1.2	40 27 14.48	+ 9 7.35	+ 1.41	— 25	+ 15	23.14	—4	68.2
	III 1	D	15.7817	23.9150	— 6	+ .3	0	40 39 49.64	— 3 26.16	— 17	+ 4	— 5	23.30	—1	68.5
	2		5.3010ii	34.0187iv	— 19	—2.1	—2.4	40 24 16.51	+12 5.24	+ 1.63	— 63	+ 23	22.98	—2	
	3		23.5537	12.5730	—125	—1.6	—1.4	40 41 0.05	— 4 37.01	— 24	— 43	— 9	22.28	—2	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Aug. 10	III 4	D	25.4123	13.8623	— 26	+ .5	— .2	40 41 15.77	— 4 51.63	— 27	+ 6	— 8	40 36 23.85	—2	68.6
	5		17.6370	21.4950	— 12	— .6	—1.8	40 37 0.69	— 1 37.40	— 4	— 32	— 3	22.90	—2	
	6		26.0820	12.0740	— 77	+ .6	0	40 42 17.32	— 5 53.58	— 27	+ 10	—13	23.44	—2	67.3
	7		16.9730	22.7577	— 4	— .3	— .2	40 38 49.22	— 2 26.09	— 11	— 7	— 4	22.91	—3	67.4
	8		25.0627	14.5333	— 15	+ .4	+1.7	40 40 49.68	— 4 25.89	— 22	+ 28	— 9	23.76	—3	66.4
	9		13.1547	24.7840	— 71	— .3	— .2	40 31 29.20	+ 4 53.52	+ 43	— 7	+11	23.19	—3	
Sept. 2	10		9.0990ii	30.7503iv	0	+ .5	+ .3	40 27 14.74	+ 9 6.82	+1.41	+ 12	+15	23.24	—4	66.7
	XI 1		27.6593	10.8663	— 74	+ .7	+1.1	40 43 27.46	— 7 3.96	— 47	+ 25	—15	23.13	+ 8	63.6
	2		7.8240ii	32.9920iv	+ 14	—1.6	—2.0	40 47 1.43	—10 35.70	—1.29	— 50	—24	23.70	+8	62.3
	3		8.6353ii	32.9180iv	+ 19	— .8	— .7	40 26 8.74	+10 13.36	+ 1.43	— 22	+18	23.49	+ 9	c
	4		8.8027ii	32.9103iv	+ 21	—3.1	—1.8	40 26 13.42	+10 8.91	+1.42	— 71	+18	23.25	+ 8	
	5		2.7920ii	34.7710iv	— 86	—2.0	—2.2	40 22 54.76	+ 13 27.48	+1.70	— 59	+ 25	23.60	+8	60.8
	6		26.2943	15.4443	+ 55	—2.5	—2.3	40 31 48.99	+ 4 34.18	+ 44	— 68	+10	23.03	+ 8	60.4
	7		18.3147	22.6417	+ 14	—1.9	—1.7	40 38 13.26	— 1 49.32	— 8	— 51	— 3	23.32	+ 8	
	8		21.6213	19.3617	+ 6	— .4	— .6	40 37 20.18	— 57.08	— 2	— 14	— 1	22.93	+8	59.7
I 1			16.9283	22.9300	— 4	—1.2	—1.7	40 33 51.65	+ 2 31.57	+ 26	— 40	+ 5	23.13	+8	59.4
	2		14.2320	28.5640	+ 118	—2.1	—2.3	40 42 26.40	— 6 2.28	— 42	— 62	—10	22.98	+8	59.1
	3		18.3327	23.5033	+ 28	—2.4	—3.5	40 34 13.03	+ 2 10.67	+ 23	— 82	+ 3	23.14	+7	
	4		23.7690	20.3000	+ 41	—2.8	—3.2	40 34 55.91	+ 1 27.72	+ 18	— 84	+ 3	23.00	+7	57.4
	5		23.3483	18.6450	+ 28	— .7	—1.8	40 34 24.56	+ 1 58.86	+ 22	— 34	+ 3	23.33	+ 7	
	6		23.0243	22.4393	+ 10	—2.0	— .3	40 36 8.65	+ 14.80	+ 11	— 35	0	23.21	+6	56.2
	7		11.9937	30.6513	+147	—1.6	—1.2	40 28 30.88	+ 7 51.61	+ 70	— 40	+15	22.94	+ 6	
	8		9.2293ii	32.8500iv	+ 22	— .5	—1.5	40 26 25.45	+ 9 56.65	+ 1.41	— 27	+ 17	23.41	+ 6	56.6
	9		14.4137	26.2100	+ 19	+ .1	— .8	40 31 24.89	+ 4 57.99	+ 46	— 8	+ 8	23.34	+ 6	
	10		26.5763	15.1940	+ 61	—1.1	—1.6	40 41 11.80	— 4 47.64	— 25	— 38	—11	23.42	+ 4	55.5
IV 2		R	26.8983	15.5523	+ 80	+ .6	— .5	40 41 10.67	— 4 46.79	— 32	+ 3	— 8	23.51	—2	50.4c
	3		11.4077ii	30.9203iv	— 5	—1.6	—1.2	40 44 37.17	— 8 12.85	—1.12	— 40	—17	22.63	—2	50.6
	4		11.5263ii	30.0657iv	— 7	—1.4	+2.4	40 44 12.11	— 7 48.26	— 1.11	+ 9	—14	22.69	—2	
	5		19.4910	23.6483	+ 38	+ .6	0	40 34 37.54	+ 1 45.11	+ 19	+ 10	+ 3	22.97	—3	50.4
	6		23.9867	16.8100	+ 16	+ 2.6	+1.4	40 39 23.82	— 3 1.31	— 19	+ 58	— 5	22.85	—3	50.8
	7		33.6890iv	8.2567ii	+ 32	— .2	+ .6	40 25 38.61	+10 42.46	+ 1.51	+ 4	+ 25	22.87	—2	
	8		28.1260	15.6913	+140	+ 2.6	+1.0	40 41 37.37	— 5 14.36	— 34	+ 53	—10	23.10	—3	50.0
	9		15.1400	28.0733	+ 123	+ .9	+2.3	40 30 56.13	+ 5 26.99	+ 50	+ 44	+10	24.16	—3	
Sept. 3	10		10.3690ii	31.8540iv	+ 10	+1.8	+ .7	40 27 18.80	+ 9 2.71	+1.34	+ 37	+17	23.39	—3	50.9
	XI 1	D	12.6183	29.4167	+ 100	+2.0	+ 1.9	40 43 27.53	— 7 4.53	— 47	+ 55	—15	22.93	+8	63.5
	2		31.3583iv	6.1143ii	— 39	+1 3	+ 1.6	40 47 1.49	—10 37.48	—1.29	+ 40	—24	22.88	+8	63.0
	5		32.9390iv	0.9913ii	—213	— .2	— .1	40 22 54.90	+ 13 26.35	+1.69	— 4	+25	23.15	+8	63.4
	6		14.1367	24.9697	— 29	+ 2.2	+1.9	40 31 49.04	+ 4 33.54	+ 43	+ 58	+ 10	23.69	+8	
	7		21.6707	17.2907	— 15	+1.7	+ 2 0	40 38 13.44	— 1 50.59	— 9	+ 52	— 3	23.25	+8	63.3
	8		18.9703	21.2353	+ 2	— .9	— .2	40 37 20.37	— 57.21	— 2	— 16	— 1	22.97	+ 8	63.2
I 1			22.5243	16.5410	— 18	— .6	+1.2	40 33 51.85	+ 2 31.07	+ 26	+ 6	+ 5	23.29	+8	
	2		27.5733	13.2003	+ 32	+1.3	+ .1	40 42 26.61	— 6 3.10	— 42	+ 22	—10	23.21	+ 8	62.9
	3		23.4920	18.3630	+ 29	—1.6	— .2	40 34 13.26	+ 2 9.61	+ 23	— 28	+ 3	22.85	+7	63.3
	4		18.8203	22.2493	+ 13	+ 2.3	+1.3	40 34 56.16	+ 1 26.64	+ 18	+ 52	+ 3	23.53	+7	
	5		17.7293	22.4007	0	+2.7	+1.3	40 34 24.81	+ 1 57.99	+ 22	+ 58	+ 3	23.63	+7	62.9
	6		19.3687	19.9217	0	+1.4	0	40 36 8.89	+ 13.97	+ 11	+ 22	0	23.19	+6	
	7		29.0497	10.4003	— 31	—1.1	— .2	40 28 31.15	+ 7 50.94	+ 70	— 20	+ 15	22.74	+6	62.2
	8		32.7397iv	9.1403ii	+ 20	— .8	+1.5	40 26 25.74	+ 9 56.09	+ 1.40	+ 6	+17	23.46	+6	c
	9		26.5940	14.8123	+ 50	0	— .9	40 31 25.19	+ 4 57.69	+ 46	— 12	+ 8	23.30	+6	60.2
	10		14.3807	25.8050	+ 6	+1.0	+ 1.8	40 41 12.06	— 4 48.55	— 25	+ 38	—11	23.53	+4	60.4
IV 1		D	21.5230	18.7480	0	— .2	— .4	40 35 13.45	+ 1 10.09	+ 17	— 8	+ 2	23.65	—3	58.2
	2		14.6943	26.0723	+ 25	0	+ .2	40 41 10.92	— 4 47.44	— 32	+ 2	— 8	23.10	—2	58.4
	4		29.4653iv	10.9557ii	0	— .2	0	40 44 12.33	— 7 47.51	—1.11	— 3	—14	23.54	—2	
	5		19.7220	15.5303	— 58	—2.0	— .2	40 34 37.74	+ 1 45.72	+ 19	— 31	+ 3	23.34	—3	58.1
	6		16.3787	23.5117	0	— .3	—1.6	40 39 24.01	— 3 0.16	— 19	— 25	— 5	23.36	—3	57.9

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Sept. 6	XI 1	D	28.8890	12.1347	+ 50	—1.5	—1.3	40 43 27.57	— 7 3.27	— 46	— 40	—15	40 36 23.29	+ 8	65.4
	2		8.4363ii	33.6057iv	+ 31	— .6	—1.4	40 47 1.67	—10 35.77	—1.29	— 28	—24	24.09	+8	64.4
	3		8.4357ii	32.6710iv	+ 15	+ .2	+2.6	40 26 9.11	+10 12.13	+1.43	+ 36	+18	23.21	+9	
	4		8.2987ii	32.3597iv	+ 9	0	— .1	40 26 13.81	+ 10 7.72	+1.42	— 2	+ 18	23.11	+ 9	63.8
	5		2.5320ii	34.4627iv	—106	— .3	— .5	40 22 55.19	+13 26.18	+ 1.69	— 11	+ 25	23.20	+ 8	
	6		26.0910	15.2710	+ 43	—1.2	—1.6	40 31 49.36	+ 4 33.38	+ 43	— 39	+ 10	22.88	+8	63.8
	7		19.2597	23.6260	+38	+ .1	+ .3	40 38 13.83	— 1 50.38	— 9	+ 6	— 3	23.39	+8	
	8		21.2337	18.9377	0	+ 1.3	+ .2	40 37 20.80	— 57.99	— 2	+ 22	— 1	23.00	+8	63.3
	I 1		15.9910	21.9413	+ 38	+ .2	+ 1.2	40 33 52.33	+ 2 30.38	+ 26	+ 18	+ 5	23.20	+8	62.9
	2		13.7580	28.1337	+ 78	—1.0	— .8	40 42 27.13	— 6 3.27	— 42	— 26	—10	23.08	+8	
	3		18.4583	23.5363	+ 33	+ 1.4	+ 1.4	40 34 13.83	+ 2 8.33	+ 23	+ 40	+ 3	22.82	+ 8	
	4		21.8943	18.4887	+ 4	— .9	— .1	40 34 56.79	+ 1 26.02	+ 17	— 16	+ 3	22.85	+7	63.1
	5		23.2667	18.6260	+ 29	+ 1.0	+1.6	40 34 25.47	+ 1 57.28	+ 22	+ 36	+ 3	23.36	+7	62.6
	6		22.5537	22.0213	+ 8	— .8	0	40 36 9.51	+ 13.47	+ 11	— 12	+ 1	22.98	+6	
	7		10.9190	29.5427	+ 26	+ 2.2	+ 1.6	40 28 31.43	+ 7 49.68	+ 70	+ 54	+ 15	22.50	+6	62.4
	8		8.4287ii	31.9767iv	+ 4	+2.1	+ 1.7	40 26 26.49	+ 9 54.75	+1.40	+ 54	+17	23.35	+6	
	9		14.6147	26.3183	+ 32	+ 2.8	+1.3	10 31 25.97	+ 4 56.43	+ 46	+ 60	+ 8	23.54	+6	62.6
Sept.	10		28.2557	16.8177	+ 172	+ 2.1	+1.5	40 41 12.76	— 4 49.31	— 26	+ 52	—11	23.60	+5	62.4
8	XI 1	D	12.6487	29.4080	+100	— .3	—1.6	40 43 27.60	— 7 3.54	— 46	— 25	—15	23 20	+8	64.3
	2		30.1987iv	4.9510ii	— 74	0	— .6	10 47 1.70	—10 37.42	—1.29	— 8	—24	22.67	+8	62.5
	3		32.6833iv	8.4307ii	+ 16	—2.2	—3.2	40 26 9.18	+ 10 12.58	+1.43	— 75	+18	22.62	+9	
	4		32.0707iv	7.9843ii	0	—1.7	—1.6	40 26 13.92	+10 8.35	+ 1.42	— 47	+18	23.40	+9	
	6		12.6573	23.4973	—123	—1.1	—1.6	40 31 49.48	+ 4 33.47	+ 42	— 38	+10	23.09	+ 8	61.6
	7		21.4173	17.0377	— 21	— .1	— .6	40 38 13.82	— 1 50.56	— 9	— 9	— 3	23.05	+9	60.9
	8		18.8157	21.1060	0	— .5	— .7	40 37 21.01	— 57.84	— 2	— 17	— 1	22.97	+8	61.6
	I 1		23.1190	17.1630	+ 5	—1.0	— .8	40 33 52.56	+ 2 30.44	+ 26	— 26	+ 5	23.05	+8	61.5
	2		27.8447	13.4597	+ 55	— .4	—2.0	40 42 27.39	— 6 3.46	— 42	— 32	—10	23.09	+8	
	3		22.3217	17.2070	— 8	—1 4	— .8	40 34 14.12	+ 2 9.17	+ 23	— 32	+ 3	23.23	+8	61.5
	4		18.5693	21.9983	+ 5	— .8	—1.7	40 34 57.09	+ 1 26.62	+ 18	— 34	+ 3	23.58	+8	
	5		17.2563	21.9003	— 14	0	—1.1	40 34 25.81	+ 1 57.26	+ 22	— 14	+ 3	23.18	+7	60.4
	6		19.9607	20.4937	0	— .3	— .6	40 36 9.82	+ 13.46	+ 11	— 12	0	23.27	+6	59.9
	7		28 5050	9.8603	— 90	—2.1	—2.9	40 28 32.21	+ 7 50.68	+ 70	— 70	+ 15	23.04	+6	
	8		31.1760iv	7.6163ii	— 15	+ 1.1	+ 1.9	40 26 26.89	+ 9 55.00	+1.40	+ 41	+17	23.87	+6	
	9		25.3557	13.6113	— 36	—1.5	—1.0	40 31 26.39	+ 4 56.54	+ 45	— 36	+ 8	23.10	+6	59.9
	10		14.1667	25.6517	— 6	— .9	— .3	40 41 13.13	— 4 50.06	— 26	— 18	—11	22.52	+ 5	59.1
	IV 1	D	22.9080	20.1960	+ 24	—1.6	—1.0	40 35 14.72	+ 1 8.56	+ 17	— 38	+ 2	23.09	—1	54.9
	2		14.6573	26.0693	+ 25	—1.0	— .8	40 41 12.21	— 4 48.31	— 32	— 26	— 8	23.24	—1	
	3		27.9647iv	8.4097ii	+ 4	+1.0	— .4	40 44 38.56	— 8 13.93	—1.12	+ 10	—17	23.44	—2	54.9
	4		29.3190iv	10.7610ii	0	— .4	—1.7	40 44 13.08	— 7 48.74	—1.11	— 28	—14	22.81	—2	54.8
	5		19.9633	15.8183	— 52	—3.2	—2.0	40 34 38.84	+ 1 44.56	+ 19	— 75	+ 3	22.87	—2	
	6		16.3757	23.5773	0	— .2	— .1	40 39 25.06	— 3 1.90	— 19	— 4	— 5	22.88	—2	
	7		3.8607ii	29.2927iv	—110	— .4	— .1	40 25 39.66	+ 10 42.09	+1.51	— 8	+25	23.43	—2	53.9d
	8		12.2633	24.7083	—111	— .8	—1.5	40 41 38.35	— 5 14.06	— 34	— 32	—10	23.53	—3	53.7
	9		25.3760	12.4683	— 81	+ .5	+ 1.6	40 30 57.04	+ 5 25.82	+ 50	+ 28	+ 10	23.74	—3	
	10		30.6280iv	9.1747ii	0	— .1	+ .3	40 27 19.62	+ 9 1.86	+1.34	+ 2	+17	23.01	—3	53.9
Sept. 9	XI 1	R	28.0157	11.2607	— 36	— .9	—1.4	40 43 27.59	— 7 3.08	— 46	— 32	—15	23.58	+8	63.0
	2		8.5160ii	33.7183iv	+ 34	— .6	— .6	40 47 1.72	—10 36.61	—1.29	— 17	—24	23.41	+8	62.9
	3		9.2330ii	33.4823iv	+ 34	+2.4	+ .7	40 26 9.22	+10 11.94	+1.43	+ 46	+18	23.23	+9	
	4		8.2990ii	32.3667iv	+ 9	+ .7	— .1	40 26 13.94	+10 7.89	+1.42	+ 10	+18	23.53	+9	
	5		2.5160ii	34.4813iv	—105	+ .6	— .1	40 32 55.35	+13 26.30	+1.70	+ 8	+25	23.68	+9	62.4
	6		26.3983	15.5910	+ 64	—1.0	— .7	40 31 49.55	+ 4 33.11	+ 43	— 24	+ 10	22.95	+8	62.4
	7		18.4823	22.8727	+ 18	+ .5	+ .7	40 38 14.09	— 1 50.94	— 9	+ 16	— 3	23.19	+9	62.3
	8		21.7920	19.4833	+ 8	+ 2.1	+ .9	40 37 21.10	— 58.33	— 2	+ 44	— 1	23.18	+ 8	
	I 1		17.8630	23.7893	+ 29	+ .2	+ .9	40 33 52.67	+ 2 29.75	+ 26	+ 14	+ 5	22.87	+8	
	2		13.4840	27.8850	+ 57	+ .2	+ .6	40 42 27.50	— 6 3.86	— 43	+ 10	—10	23.21	+8	63.4

1893	Pair		P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
Sept. 9	I	3	R	18.3623	23.4500	+28	+1.4	+2.4	40 34 14.25	+ 2 8 56	+ 23	+ 52	+ 3	40 36 23.59	+8	62.8
		4		23.0733	19.6947	+27	—1.3	+.7	40 34 57.14	+ 1 25.40	+17	— 11	+3	22.63	+8	62.8
		5		23.1487	18.5340	+25	—1.0	+.4	40 34 25.97	+ 1 56.61	+ 21	— 10	+3	22.72	+7	
		6		20.8577	20.3567	0	0	+.4	40 36 9.98	+ 12.66	+ 11	+ 5	0	22.80	+6	62.5
		7		11.0243	29.6050	+34	+.7	0	40 28 32.38	+ 7 49.37	+ 69	+ 11	+15	22.70	+7	
		8		9.0907ii	32.6250iv	+18	+.9	—.1	40 26 27.08	+ 9 54.43	+1.40	+12	+17	23.20	+7	
Sept. 12		9		14.4227	26.1293	+19	+1.3	+.4	40 31 26.59	+ 4 55.71	+ 45	+ 25	+8	23.08	+6	62.4
	XI	2	D	32.0857iv	6.8653ii	— 18	—1.1	— .7	40 47 1.83	—10 36.93	—1.29	— 26	—24	23.11	+8	61.6
		3		32.5263iv	8.2943ii	+12	+.1	—1.7	40 26 9.40	+10 12.04	+1.43	— 20	+18	22.85	+9	
		5		32.1820iv	0.2533ii	—266	+.6	+.4	40 22 55.57	+13 25.74	+1.69	+ 14	+25	23.39	+9	61.9
		6		14.1950	24.9920	— 26	— .7	—1.3	40 31 49.79	+ 4 32.63	+43	— 28	+10	22.67	+9	
		7		22.0317	17.6343	— 6	+.4	— .2	40 38 14.38	— 1 51.05	— 9	+ 4	— 3	23.25	+9	62.2
		8		18.9220	21.2023	0	—2.1	—2.5	40 37 21.44	— 57.59	— 2	— 64	— 1	23.18	+9	
	I	1		22.6637	16.7403	— 11	— .8	— .3	40 33 53.04	+ 2 29.58	+ 26	— 16	+ 5	22.77	+9	61.9
		2		27.7100	13.3073	+42	— .6	—2.0	40 42 27.50	— 6 3.87	— 43	— 35	—10	22.75	+8	
		3		22.8937	17.8213	+12	— .5	0	40 34 14.69	+ 2 8.14	+ 23	— 8	+3	23.01	+8	61.9
		4		18.9493	22.3440	+12	— .4	—1.1	40 34 57.72	+ 1 25.77	+ 17	— 20	+3	23.49	+8	
		5		18.2340	22.8683	+15	— .2	—1.1	40 34 26.47	+ 1 57.09	+22	— 17	+3	23.64	+9	
		6		19.4577	19.9667	0	—1.6	— .2	40 36 10.45	+ 12.86	+ 11	— 28	+1	23.15	+7	60.9
		7		29.2500	10.6443	— 8	—1.7	—2.5	40 28 32.91	+ 7 49.89	+ 70	— 58	+15	23.07	+7	
Sept. 16		8		32.3317iv	8.8140ii	+12	— .8	—1.0	40 26 27.67	+ 9 54.01	+1.40	— 25	+17	23.00	+7	60.9
	XI	2	R	7.9217ii	33.1220iv	+17	— .3	— .9	40 47 2.07	—10 36.51	—1.29	— 16	—24	23.87	+8	64.4
		3		9.2383ii	33.4533iv	+32	+.3	— .1	40 26 9 72	+10 11.66	+1.43	+ 3	+18	23.02	+9	63.9
		4		9.2603ii	33.3207iv	+31	—1.7	—1.3	40 26 14.49	+10 7.76	+1.42	— 43	+18	23.42	+9	
		5		1.8200ii	33.7447iv	—156	— .8	—2.0	40 22 55.96	+13 25.90	+1.69	— 38	+25	23.42	+9	63.9
		6		25.7473	14.9530	+22	—1.6	—1.8	40 31 50.21	+ 4 32.68	+43	— 48	+10	22.94	+9	
		7		19.3787	23.7870	+41	— .7	+.3	40 38 14.91	— 1 51.45	— 9	— 7	— 3	23.27	+9	
		8		22.5163	20.2080	+18	— .5	—1.8	40 37 22.00	— 58.34	— 2	— 30	— 1	23.33	+9	a
	I	1		17.7633	23.6637	+24	— .3	0	40 33 53.64	+ 2 29.08	+ 26	— 4	+5	22.99	+9	62.6
		2		13.1730	27.6187	+35	— .2	—1.7	40 42 28.56	— 6 4.93	— 43	— 24	—10	22.86	+9	62.1
		3		18.5827	23.6423	+34	— .9	— .5	40 34 15.41	+ 2 7.87	+ 23	— 20	+3	23.34	+8	
		4		22.3640	19.0067	+14	0	—1.0	40 34 58.47	+ 1 24.83	+ 17	— 12	+3	23.38	+8	61.9
Sept. 17		5		22.6987	18.0997	+12	—1.4	—1.0	40 34 27.28	+ 1 56.18	+ 21	— 34	+ 3	23.36	+8	61.6
	IV	2	R	26.0597	14.5750	+22	+1.3	+.4	40 41 14.09	— 4 50.14	— 33	+ 25	— 8	23.79	0	55.4
		3		11.6017ii	31.2463iv	— 4	— .7	— .2	40 44 40.20	— 8 16.17	—1.12	— 14	—17	22.60	—1	55.4d
		4		11.0313ii	29.6633iv	0	— .7	+.3	40 44 15.14	— 7 50.61	—1.12	— 7	—14	23.20	—1	
		5		20.5997	24.6303	+62	+2.1	+1.6	40 34 40.39	+ 1 41.96	+19	+ 53	+3	23.10	—2	54.4
		6		24.5557	17.2960	+38	+.8	+.3	40 39 26.54	— 3 3,46	— 19	— 16	— 5	23.00	—2	
		7		33.7780iv	8.4283ii	+35	—1.4	—1.3	40 25 40.85	+10 40.36	+1.51	— 38	+25	22.59	—2	54.1
		8		27.9110	15.4243	+121	+2.0	+.6	40 41 39.46	— 5 15.70	— 34	+ 38	—10	23.70	—2	
Sept. 19	IV	1	D	20.6383	18.0257	— 10	+.2	0	40 35 17.08	+ 1 5.96	+ 17	+ 3	+ 2	23.26	0	67.1
		2		12.9167	24.4630	— 89	+.7	+.5	40 41 14.63	— 4 51.39	— 33	+ 18	— 8	23.01	0	66.7
		3		30.7853iv	11.1400ii	0	— .1	+.2	40 44 40.67	— 8 16.15	—1.12	+ 1	—17	23.24	—1	
		4		29.9403iv	11.2840ii	— 5	+.2	+.3	40 44 15.61	— 7 51.17	—1.12	+ 7	—14	23.25	—1	
		5		22.5953	18.5607	+15	— .9	+.2	40 34 40.84	+ 1 41.93	+19	— 12	+ 3	22.87	—1	66.6
		7		4.8510ii	30.2013iv	— 77	— .1	0	40 25 41.21	+10 40.05	+1.51	— 2	+25	23.00	—2	66.0
Sept. 20		8		13.2157	25.7837	— 37	+1.3	+1.7	40 41 39.81	— 5 17.32	— 34	+ 42	—10	22.47	—2	66.2
	IV	1	R	19.5463	22.1737	+13	—1.7	—2.3	40 35 17.34	+ 1 6.39	+ 17	— 56	+2	23.36	0	57.6
		2		26.7037	15.1987	+64	+.2	+1.0	40 41 14.63	— 4 50.74	— 33	+ 16	— 8	23.64	0	
		3		11.1380ii	30.7670iv	0	—1.8	—1.2	40 44 40.91	— 8 15.78	—1.12	— 44	—17	23.40	—1	58.8
		4		11.2947ii	29.9447iv	— 6	—3.6	— .6	40 44 15.84	— 7 51.04	—1.12	— 64	—14	22.90	—1	
		5		23.2503	27.2463	+125	+1.2	+.1	40 34 41.07	+ 1 41.24	+ 19	+ 20	+ 3	22.73	—1	57.4
		6		24.1447	16.9260	+23	—1.2	—1.5	40 39 27.19	— 3 2.38	— 19	— 38	— 5	24.19	—1	
		7		32.5473iv	7.2057ii	— 4	—1.9	— .8	40 25 41.40	+10 40.05	+1.51	— 40	+25	22.81	—1	
		8		28.2203	15.7377	+144	— .3	—1.0	40 41 39.99	— 5 15.64	— 34	— 17	—10	23.74	—2	56.6

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Sept. 20	IV 9	R	14.7240	27.5737	+ 89	+ .2	— .6	40 30 58.54	+ 5 24.77	+ 50	— 4	+10	40 36 23.87	—2	
	10		10.0707II	31.4963IV	+ 7	+1.1	— .5	40 27 20.95	+ 9 1.17	+1.34	+ 10	+17	23.73	—2	56.6
	V 1		28.5160	12.6090	+ 51	—3.2	— .2	40 29 40.24	+ 6 41.90	+ 60	— 52	+11	22.33	—2	56.6
	2		18.6530	23.2260	+ 26	— .1	0	40 38 18.93	— 1 55.57	— 9	— 2	— 3	23.22	—3	56.7
	3		10.3907II	33.9510IV	+ 46	— .8	— .3	40 26 26.29	+ 9 55.19	+1.47	— 16	+23	23.02	—2	*d*
	4		14.7700	29.2033	+167	—1.3	—1.4	40 42 29.32	— 6 4.97	— 42	— 38	—11	23.44	—3	
	5		33.3567IV	9.8037II	+ 34	—2.9	— .2	40 26 27.25	+ 9 54.98	+1.42	— 48	+19	23.36	—3	55.5
	6		23.0443	22.0013	+ 17	+ .7	— .3	40 36 49.68	— 26.39	+ 9	+ 7	— 1	23.44	—3	
Sept. 21	7		13.6143	28.4457	+ 89	—2.0	+ .5	40 42 38.86	— 6 14.83	— 42	— 24	—12	23.25	—3	
	IV 1	D	21.2007	18.5860	0	— .7	—1.3	40 35 17.58	+ 1 6.05	+ 17	— 28	+ 2	23.54	0	52.6
	2		13.7667	25.2983	— 32	—2.0	—2.2	40 41 15.13	— 4 51.19	— 33	— 59	— 8	22.94	0	
	3		28.8543IV	9.1810II	0	—1.3	—1.5	40 44 41.13	— 8 16.91	—1.12	— 39	—17	22.54	0	52.4
	4		30.1463IV	11.4957II	— 7	— .6	—1.3	40 44 16.07	— 7 51.07	—1.12	— 26	—14	23.48	—1	52.2
	5		22.5713	18.5397	+ 13	—1.2	— .5	40 34 41.28	+ 1 41.86	+ 19	— 25	+ 3	23.11	—1	
	6		17.8233	25.0887	+ 62	—1.7	—1.1	40 39 27.41	— 3 3.67	— 19	— 40	— 5	23.10	—1	51.8
	8		12.7937	25.3140	— 69	— .7	— .4	40 41 40.16	— 5 16.06	— 34	— 16	—10	23.50	—2	51.9
	9		26.7080	13.8717	+ 23	—1.9	— .7	40 30 58.71	+ 5 24.28	+ 50	— 38	+10	23.21	—2	
	10		30.5980IV	9.1870II	0	— .4	— .3	40 27 21.11	+ 9 0.81	+1.34	— 10	+17	23.33	—2	
	V 1		11.9567	27.8633	— 8	+ .6	— .1	40 29 40.38	+ 6 41.76	+ 60	+ 8	+11	22.93	—2	51.3
	2		23.8790	19.2703	+ 43	+1.6	+1.6	40 38 19.11	— 1 56.51	— 9	+ 46	— 3	22.94	—3	
Sept. 22	3		31.1553IV	7.5743II	— 15	—1.4	0	40 26 26.40	+ 9 55.58	+1.47	— 22	+23	23.46	—2	
	IV 1	R	19.3177	21.8973	+ 9	— .8	+1.7	40 35 17.72	+ 1 5.17	+ 17	+ 9	+ 2	23.17	0	56.5
	2		26.6190	15.0837	+ 58	+ .7	—1.4	40 41 15.58	— 4 51.50	— 33	— 7	— 8	23.60	0	
	3		12.2370II	31.9300IV	— 4	— .8	— .8	40 44 41.53	— 8 17.39	—1.05	— 22	—17	22.70	0	56.4
	4		11.2080II	29.9270IV	— 6	+1.0	+1.0	40 44 16.48	— 7 52.78	—1.05	+ 28	—14	22.79	—1	55.6
	5		18.8803	22.8993	+ 21	+1.2	— .2	40 34 41.69	+ 1 41.56	+ 19	+ 16	+ 3	23.63	—1	
	6		25.3697	18.0827	+ 77	— .4	0	40 39 27.79	— 3 4.25	— 20	— 6	— 5	23.23	—1	
	7		34.6610IV	9.3477II	+ 63	—1.0	— .9	40 25 41.91	+10 39.52	+1.43	— 27	+25	22.84	—1	56.2
	8		27.6550	15.1517	+105	—1.0	—1.0	40 41 40.48	— 5 16.07	— 34	— 28	—10	23.69	—2	56.0
	9		14.7143	27.5057	+ 82	+2.0	+ .6	40 30 59.01	+ 5 23.28	+ 50	+ 38	+10	23.27	—2	
	10		11.9420II	33.3263IV	+ 24	+ .8	— .2	40 27 21.39	+ 9 0.18	+1.27	+ 10	+17	23.11	—2	
	V 1		29.7400	13.8513	+166	—3.1	—1.6	40 29 40.67	+ 6 41.73	+ 60	— 68	+11	22.43	—2	
	2		18.7050	23.3033	+ 28	0	— .4	40 38 19.30	— 1 56.21	— 9	— 5	— 3	22.92	—2	55.1
	4		27.0210	12.5483	— 21	+ .2	— .4	40 42 29.61	— 6 5.49	— 42	— 2	—11	23.57	—3	55.2
	5		7.0733II	30.6263IV	— 24	+ .7	+ .7	40 26 27.52	+ 9 54.83	+1.35	+ 20	+19	24.09	—3	
	6		18.8070	19.8743	— 5	—1.1	— .7	40 36 49.89	— 26.95	+ 9	— 26	— 1	22.76	—2	55.0
	7		27.9570	13.0867	+ 45	+1.7	+ .7	40 42 39.04	— 6 15.70	— 42	+ 36	—12	23.16	—3	
Sept. 27	8		22.7237	18.1943	+ 12	— .7	— .4	40 34 28.46	+ 1 54.43	+ 23	— 16	+ 4	23.00	—3	
	I 2	D	27.7683	13.3067	+ 46	— .1	— .8	40 42 29.56	— 6 5.40	— 49	— 12	—10	23.45	+9	50.2
	3		23.7950	18.8000	+ 39	— .7	— .2	40 34 16.59	+ 2 6.27	+ 25	— 14	+ 3	23.00	+9	
	4		19.5550	22.8560	+ 23	+1.3	— .1	40 34 59.81	+ 1 23.44	+ 19	+ 18	+ 3	23.65	+9	49.6
	5		17.8337	22.3470	0	+ .8	+ .5	40 34 28.76	+ 1 54.00	+ 23	+ 19	+ 3	23.21	+9	50.0
	6		19.7210	20.1470	0	— .1	—1.9	40 36 12.64	+ 10.76	+ 11	— 26	0	23.25	+8	
	7		29.7663	11.3113	+ 58	—1.0	— .1	40 28 35.41	+ 7 46.30	+ 77	— 17	+15	22.46	+8	
	8		32.3770IV	8.9697II	+ 15	+1 4	+1.2	40 26 30.42	+ 9 51.28	+1.37	+ 37	+17	23.61	+8	50.2
	9		25.6093	14.0158	— 14	— .1	— .4	40 31 30.10	+ 4 52.82	+ 50	— 6	+ 8	23.44	+8	
	10		13.9743	25.5833	— 12	—1.2	— .4	40 41 16.43	— 4 53.20	— 31	— 24	—13	22.55	+6	49.6
	II 2		19.1243	19.9077	— 3	+ .6	+ .5	40 36 42.38	— 19.78	+ 7	+ 16	0	22.83	+6	48.4
	4		22.0410	17.2523	— 13	+ .7	— .8	40 38 24.04	— 2 0.93	— 8	+ 1	— 3	23.01	+6	*a*
	5		11.7290II	29.0023IV	— 6	— .5	— .4	40 29 5.50	+ 7 16.29	+1.13	— 12	+12	22.92	+6	48.2*a*
	6		30.2797IV	10.5453II	0	—1.0	— .1	40 28 3.58	+ 8 18.48	+1.22	— 17	+14	23.25	+6	
	7		13.0347II	28.4167IV	— 20	+ .5	—1.3	40 29 53.85	+ 6 28.48	+1.05	— 9	+11	23.40	+6	
	8		27.0200	11.4127	— 74	+1.4	— .3	40 42 58.19	— 6 34.04	— 52	+ 18	—11	23.70	+5	
Sept. 28	9		17.6263	20.5270	— 16	— .2	+1.1	40 37 35.99	— 1 13.23	+ 1	+ 11	— 2	22.86	+4	48.3
	I 12		13.4670	27.9367	+ 59	+1.1	+ .7	40 42 29.67	— 6 5.63	— 49	+ 26	—10	23.71	+9	51.9

1893	Pair		P	Micrometer		C	Levels A	Levels B	½(δ − δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
Sept.									° ′ ″					° ′ ″		
28	I	3	D	19.5267	24.5493	| 60	—2.2	—2.4	40 34 16.72	+ 2 7.01	| 25	— 64	+ 3	40 36 23.37	| 8	51.5
		4		23.0000	19.6937	| 26	—2.8	—2.2	40 34 59.95	| 1 23.58	+ 19	— 72	| 3	23.03	| 8	
		5		21.8747	17.3313	— 12	—1.9	— .9	40 34 28.92	| 1 54.73	| 23	— 41	| 3	23.50	+ 9	
		6		22.1217	21.7373	+ 6	+ 1.7	| 1.9	40 36 12.78	| 9.72	| 10	| 50	0	23.10	| 8	51.2
		7		11.5767	30.0217	+ 85	+ .8	+ .3	40 28 35.58	+ 7 46.11	+ 77	+ 16	+15	22.77	| 8	
		8		9.3980[ii]	32.8053[iv]	| 22	| 1.2	— .3	40 26 30.61	+ 9 51.29	| 1.37	| 14	| 17	23.58	| 8	51.1
		10		27.5210	15.9350	| 118	| .1	+ .1	40 41 16.61	— 4 52.95	— 31	+ 3	—13	23.25	+ 6	
	II	1		18.2543	19.5707	— 7	— .6	— .3	40 36 56.49	— 33.23	| 8	— 14	— 1	23.19	+ 6	
		2		20.8690	20.0917	| 3	+ 1.1	| 1.5	40 36 42.59	— 19.61	+ 7	| 36	0	23.38	+6	
		4		19.1540	23.9600	+ 44	— .2	— .5	40 38 21.26	— 2 1.50	— 8	— 10	— 3	22.55	+ 6	50.4
		5		28.9383[iv]	11.6770[ii]	— 6	—2.4	— .8	40 29 5.75	+ 7 15.98	| 1.13	— 47	+12	22.51	| 6	
		6		10.4350[ii]	30.1353[iv]	0	| 2.5	+2.5	40 28 3.83	| 8 17 60	+1.22	+ 70	| 14	23.49	+6	49.3
Sept.		7		28.6610[iv]	13.3170[ii]	— 28	| .6	0	40 29 54.10	| 6 27.49	+1.05	| 10	+11	22.85	| 6	50.1
29	I	2	D	27.5997	13.0967	+ 31	+ 3.1	+2.3	40 42 29.79	— 6 6.41	— 49	+ 78	—10	23.57	+9	51.8*b*
		3		23.7187	18.7777	| 40	+ .3	+ .9	40 31 16.85	| 2 5.67	+ 25	| 16	+ 3	22.96	| 9	
		4		19.4387	22.7133	| 20	| 1.6	| .1	40 35 0.10	+ 1 22.77	| 18	+ 26	| 3	23.34	| 9	51.5
		5		18.1453	22.6570	| 13	+ .2	— .9	40 31 29.08	+ 1 54.00	+ 23	— 8	+ 3	23.26	+ 9	
		6		18.4407	18.8223	— 4	+1.1	— .1	40 36 12.95	| 9.63	+ 10	+ 16	0	22.84	| 8	51.1
		7		30.1383	11.7117	| 100	+ .5	+1.0	40 28 35.76	| 7 45.69	+ 77	+ 20	| 15	22.57	+8	
		8		32.3193[iv]	8.9670[ii]	| 13	| 1.1	+3.4	40 26 30.81	+ 9 49.88	| 1.36	+ 60	| 17	22.82	+8	50.4
		9		25.9837	14.4420	+ 13	+1.6	+1.4	40 31 30.51	+ 4 51.56	+ 50	+ 43	+18	23.18	+8	
		10		13.1683	21.8223	— 70	| .4	| .8	40 41 16.83	— 4 54.19	— 31	+ 16	—13	22.36	| 6	50.1
	II	1		20.4793	19.1573	0	—1.4	—2.0	40 36 56.59	— 33.39	| 8	— 47	— 1	22.80	+6	
		2		18.6597	19.4523	— 3	— .4	+ .3	40 36 42.80	— 20.01	+ 7	— 2	— 1	22.83	+ 6	
		3		10.8613	27.5967	— 75	+ .9	0	40 29 19.60	+ 7 2.52	+ 70	+ 14	+13	23.09	| 7	49.5
		4		22.5390	17.7097	0	+ .6	— .2	40 38 24.49	— 2 1.99	— 8	| 7	— 3	22.46	| 6	49.6
		5		11.3097[ii]	28.5583[iv]	0	| 2.3	+ .8	40 29 6.01	+ 7 15.67	| 1.13	+ 46	+12	23.39	+6	
		6		31.6503[iv]	11.9567[ii]	— 3	— .4	+1.4	40 28 4.10	+ 8 17.43	+1.22	+ 12	| 14	23.01	| 6	49.1
		7		14.1757[ii]	29.5133[iv]	— 51	| 1.3	+ .8	40 29 54.38	| 6 27.28	+1.05	+ 30	+11	23.12	+6	
		8		28.3907	12.7603	+ 52	| 1.7	| .2	40 42 58.71	— 6 34.94	— 52	| 29	—11	23.43	+5	
		9		19.6037	22.5100	+ 17	— .2	+ .7	40 37 36.47	— 1 13.46	+ 1	| 6	— 2	23.06	+4	49.1
	V	1	R	28.6147	12.7603	+ 61	+ .7	| .4	40 29 41.25	| 6 40.64	+ 66	+ 16	| 11	22.82	—2	45.7
		2		18.9317	23.5413	| 34	+ .8	— .3	40 38 19.77	— 1 56.52	— 11	+ 8	— 3	23.19	—2	45.6
		3		9.9010[ii]	33.4557[iv]	| 36	— .6	+ .2	40 26 26.90	| 9 55.00	+1.44	— 7	+24	23.51	—2	
		4		13.2317	27.7237	+ 41	—2.1	— .2	40 42 29.95	— 6 6.17	— 48	— 35	—11	22.84	—2	
		5		32.1460[iv]	8.5583[ii]	| 8	—2.4	—1.6	40 26 27.75	+ 9 55.84	| 1.18	— 58	+19	24.38	—2	44.6*
		6		22.3390	21.2967	+ 11	0	— .9	40 36 49.99	— 26.36	| 9	— 12	— 1	23.59	—2	
		7		14.6293	29.4640	+178	—1.8	— .4	40 42 39.10	— 6 15.17	— 48	— 33	—12	23.00	—3	44.8
		8		18.5677	23.0987	+ 25	— .3	— .4	40 34 28.43	+ 1 54.51	+ 25	— 10	| 4	23.13	—3	44.5
		9		13.3943	27.2333	+ 25	—1.6	—1.4	40 42 13.89	— 5 49.63	— 46	— 43	— 9	23.28	—3	
Sept.		10		23.5420	20.3973	+ 37	+ 2.1	+ .9	40 37 43.23	— 1 19.53	— 5	+ 44	— 3	24.06	—3	43.9
30	I	2	R	12.5993	27.0997	— 13	+ .7	— .8	40 42 29.89	— 6 6.23	— 49	+ 1	—10	23.08	+9	50.4
		3		18.3863	23.3873	| 27	0	— .5	40 34 16.97	| 2 6.39	+ 25	— 6	+ 3	23.58	| 9	
		4		23.1290	19.8493	+ 29	—1.0	— .8	40 35 0.24	+ 1 22.92	+ 18	— 26	+ 3	23.11	+9	51.0
		5		24.1943	19.6960	| 52	—1.8	—1.1	40 34 29.24	+ 1 53.76	+ 23	— 42	| 3	22.84	+9	
		6		22.5923	22.1823	| 6	—1.3	—1.0	40 36 13.11	| 10.37	+ 10	— 32	0	23.26	+8	51.0
		7		11.8447[ii]	30.2907[iv]	— 9	+ .1	— .1	40 28 35.93	+ 7 45.90	+1.19	0	+15	23.17	+8	
		8		9.2243[ii]	32.6107[iv]	+ 18	+2.4	+ .1	40 26 30.99	+ 9 50.76	+1.37	+ 38	+17	23.67	| 8	
		9		15.3503	26.8967	| 78	+2.4	| .2	40 31 30.71	+ 4 51.85	+ 50	| 40	+ 8	23.54	+8	51.0
		10		27.2777	15.6893	| 101	+1.1	+ .2	40 41 16.99	— 4 52.96	— 31	| 20	—13	23.79	| 6	
	II	1		22.0733	23.4087	| 23	| 1.5	+ .1	40 36 56.79	— 33.79	| 8	| 24	— 1	23.31	| 6	
		2		23.3370	22.5350	| 12	| 1.8	+ .8	40 36 43.01	— 20.29	| 7	+ 38	— 1	23.16	| 6	50.2
		3		29.1037	12.3933	| 71	— .8	— .3	40 29 19.84	| 7 2.26	| 70	— 16	+13	22.77	| 7	49.8
		4		18.4017	23.2030	+ 25	—1.1	—2.1	40 38 24.72	— 2 1.34	— 8	— 44	— 3	22.83	| 7	
		5		30.4173[iv]	13.1503[ii]	— 28	+ .2	—1.0	40 29 6.27	| 7 16.07	+ 1.13	— 10	+12	23.49	+7	

* Turned in Azimuth.

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
Sept.					0			° ′ ″					° ′ ″		
30	II 6	R	10.8307ii	30.5327iv		+ .6	— .2	40 28 4.37	+ 8 17.65	+1.22	+ 7	+14	40 36 23.45	+ 6	48.7
	7		28.6853iv	13.3500ii	— 32	+ .5	0	40 29 54.65	+ 6 27.27	+1.05	+ 8	+11	23.16	+6	
	8		12.1377	27.7577	— 4	0	— .2	40 42 58.99	— 6 34.54	— 52	— 2	—11	23.80	+6	
	9		23.5970	20.7247	+ 37	—1.4	—1.6	40 37 36.72	— 1 12.65	+ 1	— 42	— 2	23.64	+5	48.5
	V 1	D	12.3833	28.2697	+ 29	— .3	—1.3	40 29 41.38	+ 6 41.36	+ 66	— 21	+ 11	23.30	—2	45.6
	2		21.8730	17.2623	— 14	+ .3	0	40 38 19.87	— 1 56.43	— 11	+ 4	— 3	23.34	—2	44.4
	3		31.5233iv	7.9763ii	— 6	— .2	—1.0	40 26 26 97	+ 9 54.78	+1.44	— 16	+24	23.27	—2	
	4		27.5417	13.0840	+ 27	+1.5	0	40 42 30.01	— 6 5.27	— 48	+ 23	—11	24 38	—2	
	5		7.7473ii	31.2983iv	— 12	+ .1	—1.6	40 26 27.82	+ 9 54.86	+1.39	— 19	+19	24.07	—2	45.0
	6		18.9887	20.0720	— 3	—2.7	—1.3	40 36 50.01	— 27.36	+ 9	— 58	— 1	22.15	—2	44.9
	7		27.5580	12.7150	+ 12	+ .2	—1.1	40 42 39.12	— 6 14.96	— 48	— 11	—12	23.45	—3	
	8		21.4873	16.9787	— 20	+1.7	+ .6	40 34 28.43	+ 1 53.84	+ 25	+ 34	+ 4	22.90	—3	
	9		25.8290	11.9930	— 87	+1.2	— .4	40 42 13.89	— 5 49.27	— 46	+ 14	— 9	24.21	—3	
Oct.	10		19.1683	22.3300	+ 13	— .6	0	40 37 43.21	— 1 19.90	— 5	— 10	— 3	23.13	—3	44.4
1	I 2	D	28.0270	13.5150	+ 65	— .2	+2.9	40 42 29.98	— 6 6.70	— 49	+ 34	—10	23.03	+ 9	57.9
	3		22.2557	17.3020	— 8	+ .2	+1.5	40 34 17.08	+ 2 5.10	+ 25	+ 22	+ 3	22.68	+ 9	
	4		16.8730	20.1337	— 29	+2 3	+2.6	40 35 0.35	+ 1 22.28	+ 18	+ 68	+ 3	23.52	+ 9	57.5
	5		17.5220	22.0133	— 8	+ .9	+ .1	40 34 29.37	+ 1 53.42	+ 23	+ 16	+ 3	23.21	+9	
	6		20.1677	20.5627	0	+1.4	+ .4	40 36 13.24	+ 9.98	+ 10	+ 26	0	23.58	+ 8	56.4
	7		30.0353	11.6120	+ 87	+ .6	+1.4	40 28 36.09	+ 7 45.56	+ 77	+ 28	+15	22.85	+ 8	
	8		31.7310iv	8.3767ii	0	+1.0	+2.1	40 26 31.16	+ 9 49.88	+1.36	+ 42	+17	22.99	+8	
	9		26.0273	14.4920	+ 14	+ .8	+1.2	40 31 30.90	+ 4 51.39	+ 50	+ 28	+ 8	23.15	+8	55.8
	10		14.7163	26.3540	+ 38	+1.3	+2.6	40 41 17.17	— 4 54.04	— 31	+ 53	—13	23.22	+7	55.4
	II 1		21.6140	20.2827	+ 7	+ .5	— .9	40 36 56.98	— 33.65	+ 8	— 4	— 1	23.36	+ 6	54.9
	2		20.4443	21.2507	+ 6	— .5	— .2	40 36 43.20	— 20.38	+ 7	— 10	— 1	22.78	+ 6	
	3		11.3210	28.0287	— 33	+ .9	+ .3	40 29 20.07	+ 7 1.92	+ 70	+ 18	+13	23.00	+ 7	54.4
	4		23.3237	18.4777	+ 26	+ .2	— .3	40 38 24.95	— 2 2.46	— 8	— 1	— 3	22.37	+ 6	
	5		11.2103ii	28.4340iv	+ 4	+1.7	+1.2	40 29 6.52	+ 7 15.05	+1.13	+ 42	+12	23.24	+ 7	
	6		30.8520iv	11.1633ii	0	—1.5	—1.0	40 28 4.63	+ 8 17.29	+1.22	— 36	+ 14	22.92	+ 6	54.0
	7		13.6863ii	29.0117iv	— 38	+ .3	— .1	40 29 54.97	+ 6 26.99	+1.05	+ 3	+ 11	23.15	+ 6	
	8		27.9723	12.3373	+ 13	— .8	—1.2	40 42 59.26	— 6 34.94	— 52	— 28	—11	23.41	+6	
	9		18.8117	21.7450	+ 7	—1.8	+ .8	40 37 36.98	— 1 14.10	+ 1	— 18	— 2	22.69	+ 5	53.6
	V 1	R	27.3980	11.5063	— 52	0	—1.2	40 29 41.41	+ 6 41.27	+ 66	— 16	+11	23.29	—2	49.8
	2		18.4037	23.0217	+ 21	+1.3	+ .4	40 38 20.00	— 1 56.69	— 11	+ 25	— 3	23.42	—2	
	3		10.2263ii	33.7867iv	+ 42	—2.2	—1.8	40 26 27.06	+ 9 55.20	+1.44	— 57	+24	23.37	—2	50.3
	4		13.6653	28.1327	+ 75	—2.7	—1.6	40 42 30.11	— 6 5.61	— 48	— 47	—11	23.44	—2	51.1
	5		34.8220iv	11.3260ii	+ 64	— .7	0	40 26 27.89	+ 9 53.63	+1.39	— 11	+ 19	22.99	—2	
	6		20.2920	19.2480	0	+ .3	— .3	40 36 50.07	— 26.37	+ 9	0	— 1	23.78	—2	
	7		13.3973	28.2497	+ 72	—2.7	0	40 42 39.16	— 6 15.33	— 48	— 26	—12	22 97	—3	51.1
	8		17.1270	21.6747	— 17	— .8	—1.9	40 34 28.45	+ 1 54.82	+ 25	— 36	+ 4	23.20	—3	
	9		12.8747	26.7193	— 15	— .9	— .1	40 42 13.90	— 5 49.66	— 46	— 16	— 9	23.53	—3	
Oct.	10		23.1357	20.0027	+ 29	+1.1	— .1	40 37 43.21	— 1 19.21	— 5	+ 16	— 3	24.08	—3	50.6
2	V 1	D	12.7673	28.5863	+ 63	+1.7	+1.3	40 29 41.68	+ 6 39.71	+ 66	+ 43	+11	22.59	—2	53.6
	2		23.4330	18.8267	+ 31	+ .1	— .9	40 38 20.14	— 1 56.42	— 11	— 10	— 3	23.48	—2	53.9
	3		31.2990iv	7.7487ii	— 12	—2.4	— .7	40 26 27.17	+ 9 54.80	+1.44	— 46	+24	23.19	—2	
	4		27.8283	13.3567	+ 51	0	—1.6	40 42 30.21	— 6 5.66	— 48	— 20	—11	23.76	—2	
	5		7.1870ii	30.7507iv	— 21	— .4	—3.2	40 26 27.99	+ 9 55.12	+1.39	— 47	+ 19	24.22	—2	
	6		20.1233	21.2033	+ 5	— .7	+1.2	40 36 50.13	— 27.29	+ 9	+ 4	— 1	22.96	—2	54.3
	7		27.4310	12.5593	0	— .2	— .8	40 42 39.22	— 6 15.62	— 48	— 13	—12	22.87	—3	53.6
	8		22.7840	18.2580	+ 17	+ .1	+ .3	40 34 28.49	+ 1 54.36	+ 25	+ 6	+ 4	23.20	—3	
	9		27.7390	13.8967	+ 66	+4.6	+3.3	40 42 13.93	— 5 49.80	— 46	+1.14	— 9	24.72	—3	53.2
Oct.	10		18.0300	21.2070	— 8	+1.6	+ .4	40 37 43.23	— 1 20.22	— 5	+ 30	— 3	23.23	—3	53.4
3	I 2	R	13 6880	28.1683	+ 78	+ .8	— .7	40 42 30.08	— 6 5.93	— 49	+ 4	—10	23.60	+ 9	63.4
	3		17.6790	22.6600	+ 6	+1.8	+ .6	40 34 17.22	+ 2 5.81	+ 25	+ 36	+ 3	23.67	+ 9	
	4		22.4157	19.1440	+ 17	—2.1	— .7	40 35 0.51	+ 1 22.68	+ 18	— 42	+ 3	22.98	+ 9	63.0

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
Oct.								° ′ ″					° ′ ″		
3	I 5	R	24.6127	20.1453	+ 63	— .3	+1.3	40 34 29.58	+ 1 52.99	+ 23	+ 12	+ 3	40 36 22.95	+ 9	
	6		22.2110	21.8313	+ 6	+ .3	0	40 36 13.47	+ 9.61	+ 10	+ 4	0	23.22	+ 8	
	7		11.4213	29.8497	+ 66	— .7	— .3	40 28 36.35	+ 7 45.60	+ 77	— 15	+15	22.72	+8	61.8
	8		8.6450ii	32.0200iv	+ 8	— .2	+ .1	40 26 31.46	+ 9 50.40	+ 1.37	— 2	+17	23.38	+9	
	9		13.7223	25 2647	— 34	0	— .2	40 31 31.21	+ 4 51.43	+ 50	+ 2	+ 8	23.24	+8	
	10		27.6830	16.0693	+129	+ .5	— .2	40 41 17.48	— 4 53.64	— 31	+ 5	—13	23.45	+7	60.9
	II 1		22.2283	23.5767	+ 25	— .4	— .5	40 36 57.32	— 34.12	+ 8	— 12	— 1	23.15	+ 7	60.6
Oct.	2		23.1480	22.3307	+ 11	+ .2	+ .9	40 36 43.58	— 20.67	+ 7	+ 14	— 1	23.11	+7	60.4
7	V 1	R	28.4850	12.6400	+ 53	— .9	—1.2	40 29 42.47	+ 6 40.35	+ 66	— 30	+ 11	23.29	—2	52.9a
	2		18.6653	23.3290	+ 28	— .5	—1.1	40 38 20.83	— 1 57.86	— 11	— 22	— 3	22.61	—2	53.4
	3		9.1177ii	32.6803iv	+ 19	—2.0	—2.1	40 26 27.73	+ 9 55.20	+ 1.44	— 58	+ 24	24.03	—2	d
	4		13.1767	27.7207	+ 38	— .8	+ .4	40 42 30.79	— 6 7.45	— 48	— 8	—11	22.67	—2	
	5		31.7597iv	8.2633ii	0	— .4	+ .7	40 26 28.50	+ 9 53.48	+ 1.39	+ 3	+ 19	23.59	—2	52.5
	6		22.3347	21.2527	+ 11	— .3	— .6	40 36 50.53	— 27.36	+ 9	— 12	— 1	23.13	—2	
	7		13.2953	28.1710	+ 65	— .4	+ .1	40 42 39.59	— 6 15.90	— 48	— 4	—12	23.05	—2	
	8		19.4567	23.9543	+ 45	— .9	— .1	40 34 28.79	+ 1 53.71	+ 25	— 16	+ 4	22.63	—3	52.1
	9		13.1893	27.1000	+ 11	+ .9	+ .9	40 42 14.25	— 5 51.39	— 47	+ 26	— 9	22.56	—3	
Oct.	10		21.8177	18.6230	+ 4	+1.5	+ .9	40 37 43.42	— 1 20.71	— 5	+ 34	— 3	22.97	—3	51.6
8	V 1	D	12.8740	28.6917	+ 73	—1.2	— .1	40 29 42.58	+ 6 39.71	+ 66	— 20	+ 11	22.86	—1	53.4
	2		23.3067	18.6350	+ 27	+1.5	+ .2	40 38 20.94	— 1 58.06	— 12	+ 26	— 3	22.99	—2	53.4
	3		31.1083iv	7.6137ii	— 16	+1.8	+2.5	40 26 27.80	+ 9 53.39	+ 1.44	+ 60	+ 24	23.47	—2	
	4		26.8397	12.2850	— 38	+ .6	+1.0	40 42 30.87	— 6 7.53	— 48	+ 22	—11	22.97	—2	
	5		7.8857ii	31.3997iv	— 9	+2.1	— .5	40 26 28.57	+ 9 53.89	+ 1.39	+ 26	+ 19	24.30	—2	52.6
	6		19.3413	20.4400	0	—2.1	—1.7	40 36 50.57	— 27.75	+ 9	— 54	— 1	22.36	—2	
	7		27.5937	12.7240	+ 14	— .2	— .1	40 42 39.63	— 6 15.62	— 48	— 4	—12	23.37	—2	52.2
	8		22.4077	17.8923	+ 5	+1.2	+ .6	40 34 28.81	+ 1 54.06	+ 25	+ 26	+ 4	23.42	—3	
	9		27.8377	13.9630	+ 75	+1.1	+ .4	40 42 14.21	— 5 50.64	— 47	+ 22	— 9	23.23	—3	
Oct.	10		18.4143	21.5883	0	— .8	—2.1	40 37 43.43	— 1 20.17	— 5	— 40	— 3	22.78	—3	52.6
9	V 1	R	27.0853	11.2560	— 76	—1.0	0	40 29 42.69	+ 6 39.62	+ 66	— 16	+ 11	22.92	—1	56.4
	2		16.9980	21.6643	— 20	0	—1.1	40 38 21.02	— 1 57.81	— 12	— 14	— 3	22.92	—2	56.0
	3		8.9967ii	32.4863iv	+ 16	+1.5	+1.1	40 26 27.86	+ 9 53.34	+ 1.44	+ 37	+ 24	23.25	—2	
	4		12.0800	26.6623	— 52	+2.0	+2.7	40 42 30.94	— 6 8.18	— 48	+ 66	—11	22.83	—2	55.4
	5		31.8633iv	8.3713ii	+ 3	—1.0	— .4	40 26 28.63	+ 9 53.37	+ 1.39	— 20	+ 19	23.38	—2	55.5
	6		21.0467	19.9697	+ 8	+ .5	+ .5	40 36 50.60	— 27.21	+ 9	+ 14	— 1	23.61	—2	55.1
	7		12.4847	27.3743	— 5	+2.0	+1.0	40 42 39.66	— 6 16.06	— 48	+ 44	—12	23.44	—2	
	8		17.6500	22.1577	— 3	— .4	— .9	40 34 28.82	+ 1 53.85	+ 25	— 18	+ 4	22.78	—3	55.0
	9		14.3737	28.2497	+108	—1.5	0	40 42 14.22	— 5 50.75	— 47	— 23	— 9	22.68	—3	
Oct.	10		21.7737	18.6290	+ 6	—2.4	—3.2	40 37 43.43	— 1 19.44	— 5	— 78	— 3	23.13	—3	54.1
14	I 2	D	27.9567	13.4337	+ 59	+2.0	+ .4	40 42 30.34	— 6 6.97	— 49	+ 36	—10	23.14	+9	59.6
	3		22.8003	17.8390	+ 10	— 9	— .6	40 34 17.66	+ 2 5.34	+ 25	— 22	+ 3	23.06	+9	
	4		17.8117	21.0410	— 12	+1.6	0	40 35 1.12	+ 1 21.53	+ 18	+ 25	+ 3	23.11	+ 9	59.4
	5		18.7097	23.1583	+ 28	+1.3	+2.2	40 34 30.33	+ 1 52.43	+ 23	+ 48	+ 3	23.50	+9	
	6		21.8047	22.1613	+ 5	— .3	— .6	40 36 14.26	+ 9.02	+ 10	— 12	0	23.26	+8	
	7		29.6063	11.2267	+ 45	— .2	—1.0	40 28 37.34	+ 7 44.34	+ 77	— 16	+ 15	22.44	+9	59.0
	8		32.0773iv	8.7320ii	+ 10	— .7	—1.0	40 26 32.59	+ 9 49.66	+ 1.36	— 24	+ 17	23.54	+9	58.6
	9		25.6797	14.1827	— 4	—1.9	— .4	40 31 32.47	+ 4 50.37	+ 50	— 34	+ 8	23.08	+ 9	58.6
	10		14.1163	25.8267	— 3	+1.4	+ .9	40 41 18.73	— 4 55.76	— 31	+ 33	—13	22.86	+7	58.1
	1		20.5933	19.1930	0	— .2	— .5	40 36 58.67	— 35.37	+ 8	— 10	— 1	23.27	+7	
	2		19.4533	20.2997	0	—1.8	—1.4	40 36 45.07	— 21.38	+ 7	— 46	— 1	23.29	+7	
	3		11.0983	27.7523	— 56	0	— .7	40 29 22.24	+ 7 0.49	+ 70	— 9	+ 13	23.47	+ 8	57.4
	5		10.9437ii	28.1130iv	+ 10	—1.0	—1.9	40 29 8.98	+ 7 13.68	+ 1.13	— 40	+ 12	23.51	+8	
	6		30.7927iv	11.1880ii	0	—3.3	—2.7	40 28 7.25	+ 8 15.16	+ 1.21	— 86	+ 14	22.90	+ 8	
	7		12.9127ii	28.1373iv	— 14	— .8	— .9	40 29 57.60	+ 6 24.49	+ 1.05	— 24	+ 11	23.01	+7	
	8		26.4313	10.6807	—136	— .9	—1.9	40 43 1.95	— 6 37.47	— 53	— 38	—11	23.46	+7	56.6
	9		18.8117	21.8350	+ 8	—1.1	0	40 37 39.47	— 1 16.38	+ 1	— 17	— 2	22.91	+6	56.5

1893	Pair	P	Micrometer		O	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Oct. 17	I 2	R	13.4967	28.0070	+ 64	+1.2	+2.2	40 42 30.31	— 6 6.68	— 49	+ 46	—10	40 36 23.50	+9	52.4b
	3		18.9687	23.9530	+ 44	—1.9	—1.8	40 34 17.67	+ 2 6.01	+ 25	— 52	+ 3	23.44	+9	
	4		21.8527	18.6310	+ 7	+ .7	+ .6	40 35 1.20	+ 1 21.40	+ 18	+ 18	+ 3	22.99	+9	52.0
	5		22.4137	17.9613	+ 7	+ .7	+ .9	40 34 30.45	+ 1 52.48	+ 23	+ 22	+ 3	23.41	+9	51.6
	6		22.5747	22.2427	+ 6	+1.0	+2.4	40 36 14.42	+ 8.40	+ 10	+ 46	0	23.38	+8	51.1
	7		11.5837	29.9613	+ 84	+2.0	+1.1	40 28 37.56	+ 7 44.40	+ 77	+ 45	+15	23.33	+9	
	8		9.0873ii	32.4060iv	+ 17	+2.2	+ .2	40 26 32.84	+ 9 49.05	+1.36	+ 36	+17	23.78	+9	
	9		13.5383	25.0120	— 49	+2.0	+2.3	40 31 32.76	+ 4 49.69	+ 49	+ 60	+ 8	23.62	+9	50.6
	10		14.4843	26.1670	+ 22	— .3	— .6	40 41 19.05	— 4 55.15	— 31	— 12	—13	23.34	+7	50.4
	II 1		21.9930	23.4127	+ 25	+ .2	+ .2	40 36 59.03	— 35.92	+ 8	+ 6	— 1	23.24	+7	
	2		22.9007	22.0283	+ 15	+1.0	— .8	40 36 45.47	— 22.07	+ 7	+ 6	— 1	23.52	+7	
	3		20.0703	12.4437	+ 73	—1.8	— .9	40 29 22.69	+ 7 0.16	+ 70	— 40	+13	23.38	+8	
	4		19.4110	24.3160	+ 53	— .9	— .5	40 38 27.58	— 2 4.03	— 9	— 20	— 4	23.22	+7	49.8
	5		29.7423iv	12.6263ii	— 20	— .9	— .2	40 29 9.52	+ 7 12.27	+1.13	— 16	+12	22.88	+8	
	6		10.2313ii	29.7807iv	0	+ .9	+1.0	40 28 7.83	+ 8 13.79	+1.20	+ 26	+14	23.22	+8	48.0
	7		27.6753iv	12.5083ii	— 5	+2.2	+1.6	40 29 58.20	+ 6 23.09	+1.05	+ 54	+11	22.99	+7	48.4
	8		12.2777	28.0337	+ 14	—2.3	— .8	40 43 2.56	— 6 38.02	— 53	— 46	—11	23.44	+7	48.5
Oct. 18	9		21.8670	18.8457	+ 8	—1.5	— .5	40 37 39.76	— 1 16.34	+ 1	— 30	— 2	23.11	+6	47.6
	I 2	D	27.9377	13.4463	+ 60	— .2	— .6	40 42 30.26	— 6 6.18	— 49	— 10	—10	23.39	+9	54.1
	4		17.7577	20.9983	— 15	+1.5	+ .4	40 35 1.15	+ 1 21.81	+ 18	+ 28	+ 3	23.45	+9	
	5		17.3407	21.7963	— 13	+1.0	+ .7	40 34 30.46	+ 1 52.50	+ 23	+ 24	+ 3	23.46	+9	
	6		19.7720	20.1093	0	0	— .5	40 36 14.44	+ 8.52	+ 10	— 6	0	23.00	+8	53.6
	7		30.2797	11.9117	+120	—1.1	—1.1	40 28 37.59	+ 7 44 24	+ 77	— 31	+15	22.44	+9	
	8		31.8133iv	8.5047ii	+ 3	— .7	0	40 26 32.88	+ 9 48.74	+1.36	— 11	+17	23.04	+9	
	9		26.6117	15.1490	+ 60	+ .4	+ .1	40 31 32.82	+ 4 49.68	+ 49	+ 8	+ 8	23.15	+9	53.9
	10		13.4117	25.1313	— 50	— .6	— .1	40 41 19.11	— 4 55.89	— 31	— 11	—13	22.67	+7	53.4
	II 1		20.3917	18.9550	— 2	+2.6	+1.7	40 36 59.11	— 36.29	+ 8	+ 62	— 1	23.51	+7	
	2		19.1870	20.0900	— 4	—1.9	— .3	40 36 45.54	— 22.80	+ 7	— 34	— 1	22.46	+7	
	3		11.1253	27.7363	— 55	+1.8	0	40 29 22.81	+ 6 59.42	+ 70	+ 28	+13	23.34	+8	54.6
	4		21.7217	16.7680	— 22	+1.4	+ .2	40 38 27.70	— 2 5.06	— 9	+ 24	— 4	22.75	+7	54.9
	5		10.7453ii	27.8363iv	+ 13	+1.9	+1.2	40 29 9.67	+ 7 11.72	+1.13	+ 45	+12	23.09	+8	
	6		31.0127iv	11.4613ii	— 4	— .2	— .3	40 28 7.99	+ 8 13.82	+1.21	— 7	+14	23.09	+8	
	7		13.0967ii	28.2643iv	— 22	+1.9	+ .9	40 29 58.37	+ 6 23.04	+1.04	+ 41	+11	22.97	+7	54.1
	8		28.0330	12.2523	+ 12	+ .6	+ .1	40 43 2.71	— 6 38.62	— 53	+ 11	—11	23.56	+7	
	9		18.5350	21.6117	0	+ .8	+1.6	40 37 40.23	— 1 17.71	0	+ 33	— 2	22.83	+6	53.6
Oct. 20	I 2	R	12.2267	26.7233	— 47	0	+ .5	40 42 30.14	— 6 6.04	— 49	+ 6	—10	23.57	+9	
	3		17.7050	22.6793	+ 7	+ .4	— .3	40 34 17.56	+ 2 5.66	+ 25	+ 2	+ 3	23.52	+9	
	4		22.3930	19.1287	+ 15	— .8	— .8	40 35 1.12	+ 1 22.49	— 6	— 22	+ 3	23.36	+9	52.5
	5		22.7107	18.2690	+ 13	+ .2	+ .6	40 34 30.43	+ 1 52.22	+ 23	+ 10	+ 3	23.01	+9	
	6		21.5383	21.2030	+ 3	+ .3	+ .4	40 36 14.44	+ 8.48	+ 10	+ 10	0	23.12	+8	52.6
Oct. 21	7		11.8260	30.1970	+109	+1.8	+ .3	40 28 37.62	+ 7 44.30	+ 77	+ 32	+15	23.16	+9	52.0
	I 2	D	28.2833	13.8010	+ 90	+ .2	— .6	40 42 30.08	— 6 6.03	— 49	— 4	—10	23.42	+9	53.7
	3		22.7403	17.7753	+ 9	— .3	0	40 34 17.53	+ 2 5.43	+ 25	— 4	+ 3	23.20	+9	54.0
	4		18.2897	21.5270	— 2	+ .2	+ .7	40 35 1.11	+ 1 21.76	+ 18	+ 12	+ 3	23.20	+9	
	5		17.4447	21.8910	— 9	+1.4	+2.3	40 34 30.42	+ 1 52.28	+ 23	+ 51	+ 3	23.47	+9	53.1
Oct. 24	6		18.9333	19.2640	0	+ .5	+ .6	40 36 14.43	+ 8.35	+ 10	+ 15	0	23.03	+8	
	I 2	R	13.2623	27.7457	+ 41	— .2	+ .4	40 42 29.95	— 6 5.90	— 49	+ 2	—10	23.48	+9	64.4
	3		17.8760	22.8523	+ 13	+ .1	+ .1	40 34 17.43	+ 2 5.71	+ 25	+ 3	+ 3	23.45	+9	
	4		22.8117	19.5717	+ 22	+ .4	+ .1	40 35 1.05	+ 1 21.89	+ 18	+ 8	+ 3	23.23	+9	64.0
	5		24.0137	19.6010	+ 46	+ .6	+1.8	40 34 30.41	+ 1 52.33	+ 23	+ 32	+ 3	23.32	+9	
	6		21.1747	20.8457	0	+ .8	+1.2	40 36 14.46	+ 8.31	+ 10	+ 28	0	23.15	+8	
	7		30.0963	11.7543	+100	+1.5	+2.0	40 28 37.70	+ 7 43.51	+ 76	+ 48	+15	22.60	+9	
	8		32.4210iv	9.1257ii	+ 15	+ .8	+ .7	40 26 33.05	+ 9 48.39	+1.36	+ 22	+17	23.19	+9	62.9
	9		25.6243	14.1703	— 8	+ .4	+1.2	40 31 33.05	+ 4 49.26	+ 49	+ 22	+ 8	23.10	+9	
	10		25.9963	14.2800	+ 8	+1.7	+ .3	40 41 19.39	— 4 55.93	— 31	+ 30	—13	23.32	+7	63.3

1883	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.	
Oct.								° ′ ″					° ′ ″			
24	II 1	R	20.6450	22.0867	+ 13	−1.3	— .6	40 36 59.48	— 36.45	+ 8	— 28	— 1	40 36 22.82	+ 7	63.4	
	2		21.5167	20.6293	+ 5	+ .6	+ 2.6	40 36 16.00	— 23.19	+ 6	+ 42	— 1	23.28	+ 7		
	3		30.0150	13.4540	+168	−1.5	−1.1	40 29 23.36	+ 6 58.70	+ 70	— 37	+13	22.52	+8	63.2	
	4		19.0127	23.9760	+ 14	+ .8	+ 1.0	40 38 28.28	— 2 5.46	— 9	+ 25	— 4	22.94	+ 7		
	5		29.5037[iv]	12.4333[i]	+ 96	— .2	+ .2	40 29 10.36	+ 7 11.38	1.13	0	+12	22.99	+ 8		
	6		10.3780[ii]	29.8870[iv]	0	+ 2.0	+ 1.8	40 28 8.75	+ 8 12.73	+ 1.22	+ 51	14	23.38	+ 8	63.6	
	7		28.3593[iv]	13.1997[ii]	— 21	0	— .2	40 29 59.17	+ 6 22.82	+ 1.05	— 2	+ 11	23.13	+ 8		
	8		12.1637	27.9873	+ 7	— .3	−1.1	40 43 3.57	— 6 39.67	— 53	— 18	11	23.08	+ 7		
Oct.	9		22.6777	19.6140	+ 20	−1.2	.7	40 37 41.02	— 1 17.43	0	— 28	— 2	23.29	+6	62.6	
25	VI 1	D	15.3373	23.9877	— 18	−2.7	−2.5	40 32 45.19	+ 3 38.47	+ 44	— 74	+ 7	23.43	−3	41.15	
	2		24.6123	17.5397	+ 41	−7.7	−6.2	40 33 25.69	+ 2 58.76	+ 36	−1.98	+ 5	22.88	−3		
	3		28.0593	12.1757	+ 9	+ 2.7	+ .7	40 43 5.48	— 6 41.25	— 61	+ 51	−12	24.01	−3		
	4		24.0150	17.4547	+ 29	−1.1	1.6	40 33 37.06	+ 2 45.78	+ 34	— 42	+ 5	22.81	−3	41.1	
	5		23.0350	17.8540	+ 15	— .8	+ .9	40 38 33.85	— 2 10.91	— 15	— 1	— 4	22.74	−3	41.5	
	6		9.3443[i]	30.9197[iv]	0	— .7	−1.1	40 27 16.92	+ 9 5.01	+ 1.37	— 25	+ 20	23.25	−3		
	7		21.1510	19.0450	0	−1.4	−1.2	40 37 16.60	— 53.20	— 3	— 37	— 2	22.98	−4		
	8		12.8600	28.7753	+ 78	— .6	+ .1	40 43 5.69	— 6 42.22	— 61	— 8	−12	22.66	−4	41.0	
	9		29.6893[iv]	9.4517[ii]	0	+ .5	+ 2.0	40 27 50.08	+ 8 31.21	+ 1.29	+ 33	16	23.07	−4		
	10		22.9293	16.5500	10	−3.9	−1.5	40 33 42.19	+ 2 41.11	+ 33	— 80	+ 5	22.88	−4	40.9	
	11		11.4380	27.5157	+ 74	— .6	+ .3	40 30 51.72	+ 5 30.51	+ 63	— 6	+ 10	22.93	−4		
Oct.	12		30.0793	8.1223	−117	− 3.0	−1.7	40 27 7.92	— 9 14.35	+ 1.01	— 68	+ 18	22.78	−4	41.6	
28	VI 1	R	25.8567	17.2277	+ 77	— .5	0	40 32 45.11	+ 3 38.16	+ 44	+ 8	+ 7	23.89	−3	43.4	
	2		16.9347	23.9593	+ 18	+ .9	— .5	40 33 25.63	— 2 57.48	+ 36	+ 8	+ 5	23.60	−3		
	3		13.0497	28.9240	+ 91	+ .7	+ .2	40 43 5.39	— 6 41.22	— 61	+ 11	−12	23.58	−3	42.9	
	4		17.6763	24.2767	+ 39	− .2	— .3	40 33 36.88	+ 2 46.82	+ 34	— 7	+ 5	24.02	−3		
	5		17.4317	22.5917	0	+ .6	+ 1.3	40 38 33.65	— 2 10.84	— 15	+ 26	— 4	22.88	−3	43.4	
	6		32.0150[iv]	10.4247[ii]	+ 11	+ 1.9	+ 1.1	40 27 16.68	+ 9 5.38	+ 1.37	+ 41	+ 20	24.07	−3		
	7		19.5593	21.6427	+ 8	−2.2	−1.1	40 37 16.22	— 52.65	— 3	— 48	— 2	23.14	−4		
	8		28.7170	12.8487	+ 75	— .8	−1.3	40 43 5.37	— 6 41.03	— 60	— 29	−12	23.33	−4	42.9	
	9		11.1590[ii]	31.1197[iv]	0	−1.2	−1.1	40 27 49.85	+ 8 32.55	+ 1.24	— 36	+ 16	23.44	−4		
Oct.	10		16.9313	23.3357	+ 5	+ 1.1	+ 1.0	40 33 41.75	+ 2 41.79	+ 33	+ 30	+ 5	24.22	−4	43.1	
29	VI 1	D	15.8880	24.5253	+ 11	— .8	−3.2	40 32 45.17	+ 3 38.21	+ 44	— 54	+ 7	23.35	−3	36.4	
	2		24.6057	17.5903	+ 45	−2.6	−1.3	40 33 25.65	+ 2 57.33	+ 36	— 57	+ 5	22.82	−3		
	3		28.7960	12.9423	+ 82	−1.7	+ 1.3	40 43 5.39	— 6 40.69	— 60	— 10	−12	23.88	−3	37.2	
	4		23.6700	17.1027	+ 16	2.8	— .6	40 33 36.86	+ 2 45.94	+ 31	— 51	+ 5	22.68	−3		
	5		23.1203	17.9777	+ 17	+ .3	— .5	40 38 33.61	— 2 9.95	— 15	— 2	— 4	23.45	−3		a
	6		8.5807[ii]	30.1623[iv]	— 5	+ .2	+ .5	40 27 16.63	+ 9 5.16	+ 1.26	+ 10	+20	23.35	−3		
	7		21.5050	19.4090	+ 5	+ .9	— .1	40 37 16.26	— 52.96	— 3	+ 12	— 2	23.37	−4		
	8		12.1040	28.0007	+ 4	−1.7	+ .1	40 43 5.29	— 6 41.58	— 60	— 25	−12	22.74	−4	36.6	
	9		31.0177[iv]	10.7830[ii]	0	+ .3	+ .7	40 27 49.65	+ 8 31.91	+ 1.18	+ 14	+ 16	23.04	−4	36.4	
	10		23.3303	16.9493	+ 5	+ .2	+ .1	40 33 41.63	+ 2 41.19	+ 33	+ 4	+ 5	23.24	−4	36.5	
	11		12.8850	26.0197	— 43	+ 1.5	+ .4	40 30 51.13	+ 5 31.69	+ 63	+ 28	+ 10	23.83	−4		
Oct.	12		30.2763	8.3077	— 90	−1.6	+ .7	40 27 7.25	+ 9 14.72	+1.01	— 16	+ 18	23.00	−4	36.4	
30	VI 1	R	25.2563	16.6133	+ 48	−1.1	— .1	40 32 45.22	+ 3 38.46	+ 44	— 18	+ 7	24.01	−3	31.4	
	2		16.1147	23.0953	— 17	+ 2.4	+ 3.4	40 33 25.68	+ 2 56.30	+ 36	+ 80	+ 5	23.19	−3		b
	3		12.9173	28.7980	+ 81	+ 1.8	— .9	40 43 5.42	— 6 41.39	— 60	+ 16	−12	23.47	−3		
	4		17.9713	24.5500	+ 48	— .9	+2.0	40 33 36.86	+ 2 46.32	+ 34	+ 40	+ 5	23.97	−3	31.5	
	5		17.9310	23.0653	+ 15	−2.0	— .9	40 38 33.60	— 2 9.74	— 15	— 42	— 4	23.25	−3		
	6		31.4373[iv]	9.8267[ii]	+ 5	0	+ .5	40 27 16.60	+ 9 5.70	+1.26	+ 6	+20	23.82	−3		
	7		19.4680	21.5847	+ 8	+ .7	— .2	40 37 16.21	— 53.50	— 3	+ 8	— 2	22.74	−4		
	8		27.9210	12.0860	0	— .7	−1.0	40 43 5.23	— 6 40.10	— 60	— 24	−12	24.17	−4	31.5	
	9		10.6640[ii]	30.9510[iv]	0	0	+ .1	40 27 49.57	+ 8 32.49	+ 1.18	+ 2	+ 16	23.42	−4	31.0	
	10		18.6797	25.0197	+ 72	+ 4.4	+4.6	40 33 41.53	+ 2 40.35	+ 33	+ 1.31	+ 5	23.57	−4	31.4	
	11		27.3030	14.1927	+ 58	+ 1.6	+ 3.2	40 30 51.02	+ 5 31.34	+ 63	+ 68	+ 10	23.77	−4		
	12		9.4387	31.4597	+ 53	−2.4	−1.9	40 27 7.12	+ 9 16.44	+ 1.02	— 63	+ 18	24.13	−4	31.0	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
								° ′ ″					° ′ ″		
Oct. 31	II 1	D	20.5410	19.0810	0	+2.0	.2	40 37 0.12	— 36.88	7	31	— 1	10 36 23.64	7	38.0
	2		20.1450	21.0903	+ 5	0	— .2	40 36 46.72	— 23.89	6	2	— 1	22.86	8	
	3		11.6127	28.1897	— 9	+1.9	+2.0	10 29 24.20	+ 6 57.97	+ 77	+ 56	+13	23.63	8	37.4
	4		21.6737	16.6473	— 27	1.9	+2.4	40 38 29.17	— 2 6.91	— 11	+ 62	— 4	22.73	7	
	5		11.7463ii	28.7897iv	- 6	+ .1	+ .8	10 29 11.36	+ 7 10.53	+1.01	+ 12	+ 12	23.17	8	
	6		29.7930iv	10.3117ii	0	— .3	— .4	10 28 9.86	+ 8 12.12	+1.13	— 10	+13	23.14	8	37.4
	7		13.1393ii	28.2340iv	— 19	+2.6	+2.2	10 30 0.32	+ 6 21.26	+ 94	+ 70	+11	23.33	+8	
	8		27.4257	11.5597	— 45	0	— .2	40 43 4.76	— 6 40.68	— 60	- 2	—12	23.31	+8	
	9		18.3463	21.4823	0	—1.8	— .5	40 37 42.20	— 1 19.21	— 1	— 36	— 3	22.59	6	37.6
	III 1		17.5220	26.4933	+ 105	0	+ .2	40 40 10.69	— 3 46.89	— 32	+ 2	— 7	23.13	7	37.6
	2		3.8333ii	31.7390iv	—101	— .7	—1.0	40 24 37.22	+11 44.67	+1.51	- 24	+21	23.37	7	
	4		27.4530	15.0607	+ 91	+ .7	+1.8	10 41 36.96	— 5 13.28	- 17	+ 35	— 8	23.18	+7	37.6
	5		18.0923	22.7447	+ 14	.3	— .1	40 38 20.58	— 1 57.56	— 13	- 4	— 4	22.89	6	
	6		27.3587	12.6620	0	.4	+ .4	40 42 35.40	— 6 11.25	— 49	+ 12	—11	23.61	+5	
	7		17.3630	23.9570	+ 25	+ .1	+ .9	10 39 9.76	— 2 46.61	— 22	+ 13	— 5	22.98	+5	37.2
	8		26.8380	15.5873	+ 81	+1.4	+1.7	40 41 8.46	— 4 41.11	— 40	+ 41	—10	23.99	—5	
	9		15.1520	26.0553	+ 39	+1.4	+1.2	40 31 46.95	+ 4 35.53	+ 56	+ 38	+10	23.52	+4	
	10		9.2673ii	30.1623iv	0	.6	— .2	40 27 34.18	+ 8 47.83	+1.19	+ 7	+15	23.12	5	36.5
	VI 1	D	15.7380	24.3573	+ 4	+.6	0	40 32 45.27	+ 3 37.75	+ 44	+ 10	+ 7	23.63	3	33.5
	2		23.8717	16.8533	+ 16	—2.0	—1.8	40 33 25.77	+ 2 57.34	+ 36	— 56	+ 5	22.96	—3	
	4		24.3933	17.8097	+ 15	— .3	+ .1	40 33 36.87	+ 2 16.42	+ 31	- 4	+ 5	23.61	—3	32.8
	5		23.7650	18.6220	+ 36	+ .3	— .6	40 38 33.60	— 2 10.01	— 15	- 3	— 4	23.37	—3	
	6		10.2963ii	31.8953iv	+ 10	—2.3	—3.7	40 27 16.59	+ 9 5.66	+1.26	- 85	+20	22.86	—3	33.2
	7		21.9003	19.8083	+ 10	— .1	— .6	40 37 16.19	— 52.87	— 3	— 10	- 2	23.17	—1	33.1
	8		12.4527	28.3503	+ 37	+ 1.7	+ .5	40 43 5.19	— 6 41.69	— 63	+ 31	—12	23.09	4	
	9		29.9627iv	9.6877ii	0	0	+ .3	10 27 49.51	+ 8 32.18	+ 1.18	+ 4	+ 16	23.07	—4	
	10		22.7717	16.3907	- 16	0	+ .7	40 33 41.45	+ 2 41.15	+ 33	+ 9	+ 5	23.07	—4	32.8
	11		14.6163	37.7633	+ 90	+ .1	+ .1	40 30 50.91	+ 5 32.35	+ 63	+ 3	+ 10	21.05	—4	
Nov. 3	12		31.7510	9.7813	+ 97	.8	+ .1	40 27 7.01	+ 9 15.17	+1.01	— 12	+ 18	23.25	—4	32.9
	II 2	R	20.8960	19.9520	+ 3	+1.5	+ 1.7	40 36 46.79	— 23.85	+ 6	+ 46	- 1	23.45	+7	48.9
	3		28.6093	12.0877	+ 33	— .2	+ .2	40 29 24.32	+ 6 57.40	+ 77	0	+ 13	22.62	+8	48.5a
	4		18.7677	23.7700	+ 39	+ .6	+ 1.4	40 38 29.33	— 2 6.46	— 11	+ 28	— 4	23.00	7	
	5		29.2093iv	12.1817ii	— 12	— .3	+ .9	40 29 11.57	+ 7 10.07	+1.03	+ 6	+ 12	22.85	+8	
	6		11.2283ii	30.6763iv	— 2	+1.4	+2.0	10 28 10.11	+ 8 11.24	+1.13	+ 48	+13	23.09	8	47.6
	7		27.6570iv	12.5857ii	— 3	+ .2	+ .2	10 30 0.60	+ 6 20.68	+ 94	+ 6	+11	22.39	8	
	8		12.6850	28.5583	+ 59	— .5	+ .9	10 43 5.07	— 6 41.09	— 60	- 4	-12	23.30	+8	48.2
	9		22.5243	19.3793	+ 17	— .3	+ .2	10 37 42.52	— 1 19.48	— 1	— 2	— 3	22.98	+7	48.2
Nov. 6	III 1		24.6397	15.6240	+ 6	+2.3	+1.8	40 40 11.09	— 3 47.74	— 32	+ 60	— 7	23.56	7	48.1
	II 1	D	20.5303	19.0773	0	+1.0	+ .4	40 37 0.20	— 36.70	- 7	+ 21	— 1	23.77	+7	48.5
	2		18.1353	19.0773	- 10	- 1.7	— .9	10 36 16.85	— 23.77	+ 6	— 39	— 1	22.74	+7	
	3		11.3937	27.9383	— 33	+ .6	+ .2	10 29 21.42	+ 6 57.83	+ 77	+ 12	+13	23.27	+8	17.9
	4		21.2317	16.2073	— 39	— .6	— .4	10 38 29.16	— 2 6.82	- 11	— 14	— 4	22.35	8	47.1
	5		11.2983ii	28.3253iv	+ 5	— .7	— .3	10 29 11.72	+ 7 10.11	+1.03	- 16	+ 12	22.82	8	
	6		31.2973iv	11.8220ii	— 6	—1.2	— .7	40 28 10.31	+ 8 11.93	+1.13	— 28	+ 13	23.22	8	46.6
	7		13.7283ii	28.8170iv	— 37	+1.5	+1.2	40 30 0.82	+ 6 21.01	+ 94	+ 40	+11	23.31	8	
	8		28.0653	12.1773	+ 11	+ .8	+1.2	10 43 5.31	— 6 11.35	— 60	+ 28	—12	23.52	+8	16.2
	9		19.2133	22.3870	+ 15	0	0	10 37 42.77	— 1 19.45	— 1	0	— 3	23.28	+8	
	III 1	R	25.4967	16.4937	+ 54	+ .6	+ .7	10 40 11.41	— 3 47.55	— 32	+ 18	— 7	23.65	8	46.4
	2		34.2377iv	6.3920ii	+ 15	+1.5	0	40 24 37.95	+11 43.40	+1.50	+ 21	+21	23.30	7	16.1
	3		13.7710	25.5513	— 21	— .8	— .4	10 41 21.38	— 4 57.51	- 43	- 18	— 9	23.17	+7	16.0
	4		14.3640	26.7727	+ 41	— .1	— .3	10 41 37.81	— 5 13.54	— 47	— 6	— 9	23.65	7	45.1
	5		23.7810	19.1217	+ 40	— .2	0	40 38 21.44	— 1 57.79	— 13	— 3	— 4	23.45	+6	
	6		15.0147	29.7273	+ 205	+1.1	0	40 42 36.23	— 6 11.10	— 49	+ 18	—14	24.38	5	41.6
	7		25.4020	18.8270	+ 82	— .3	—1.4	40 39 10.75	— 2 46.29	— 22	— 23	— 5	23.96	6	41.1
	8		15.8983	27.1733	+ 102	— .6	—2.3	40 41 9.42	— 4 45.06	— 40	— 40	—10	23.46	+5	43.6

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
								° ′ ″							
Nov.															
6	III 9	R	27.5900	16.7383	+140	+ .1	0	40 31 47.88	+ 4 34.46	+ 56	+ 2	+ 10	40 36 23.02	+ 5	a
	10		29.8977[iv]	9.0507[ii]	— 3	2.7	— .9	40 27 35.21	+ 8 46.58	+1.19	— 55	+ 15	23.58	+ 5	41.3
	VI 1	R	24.6047	16.0053	+ 16	— .1	0	40 32 45.51	+ 3 37.27	+ 44	— 2	+ 7	23.30	— 2	41.0
	2		16.5087	23.5023	0	— .3	— .8	40 33 25.99	+ 2 56.67	+ 36	— 16	+ 5	22.91	— 3	
	3		14.1150	29.9620	+ 189	-1.2	— .2	40 43 5.57	— 6 40.78	— 60	— 22	—12	23.85	—3	40.4
	4		18.4507	25.0223	67	0	+ .6	40 33 36.89	+ 2 46.18	+ 31	+ 8	+ 5	23.54	-3	40.0
	5		18.3993	23.5290	31	+ .1	—1.3	40 38 33.56	— 2 9.65	— 15	— 16	— 4	23.56	- 3	
	6		32.5257[iv]	10.9377[ii]	+ 17	— .1	0	40 27 16.59	+ 9 5.37	+1.26	— 2	+ 20	23.31	—3	
	7		19.9560	22.0303	+ 12	— .7	—1.0	40 37 16.03	— 52.13	— 3	— 24	— 2	23.31	1	
	8		28.1420	12.2663	+ 18	1.9	+ 1.4	40 43 4.95	— 6 41.07	— 60	+ 48	—12	23.64	—4	39.6
	9		9.9783[ii]	30.2850[iv]	0	— .7	— .3	40 27 49.17	+ 8 32.96	+1.18	— 16	+ 16	23.31	-4	39.4
	10		18.0263	21.4327	+ 49	+1.2	+ 1.6	40 33 41.01	+ 2 41.96	+ 33	— 40	+ 5	23.55	—4	39.3
Nov.	12		9.7970	31.7720	+100	+2.5	+ .8	40 27 6.42	+ 9 15.35	+1.01	+ 50	+ 18	23.46	-4	39.6
10	II 1	R	20.2873	21.7633	+ 9	+ .9	1.0	40 37 0.36	— 37.31	+ 7	+ 28	— 1	23.39	7	41.1
	2		21.3657	20.1143	+ 5	— .5	.6	40 36 47.05	— 21.04	+ 6	— 16	— 1	22.90	+ 7	
	3		29.7347	13.2350	+142	— .4	— .3	40 29 24.67	+ 6 57.15	+ 77	— 10	+ 13	22.62	+ 8	40.4
	4		19.2367	24.2450	+ 51	+ .2	— .8	40 38 29.74	— 2 6.64	— 11	— 8	- 4	22.87	+ 7	
	5		29.3290[iv]	12.3077[ii]	— 11	— .7	+ .1	40 29 12.05	+ 7 9.91	+1.03	— 10	+ 12	23.04	8	40.2
	6		10.0650[ii]	29.5163[iv]	0	+ 1.0	+ .9	40 28 10.68	+ 8 11.35	+1.13	+ 28	+ 13	23.57	+ 8	39.9
	7		26.7797[iv]	11.6947[ii]	+ 24	— .7	— .3	40 30 1.22	+ 6 21.11	+ 91	— 16	+ 11	23.22	+ 8	40.2
	8		13.0707	28.9480	92	— .8	— .9	40 43 5.74	— 6 41.30	— 60	— 24	—12	23.48	+ 8	40.3
	9		21.9727	18.8240	+ 9	— .9	— .8	40 37 43.21	— 1 19.56	— 1	— 25	— 3	23.36	7	
	III 1	D	16.2083	25.2477	+ 39	0	.2	40 40 11.92	— 3 48.44	32	— 2	- 7	23.07	8	39.8
	2		4.1770[ii]	32.0303[iv]	— 88	+1.0	— .1	40 24 38.48	+ 11 43.37	+1.50	+ 14	+ 21	23.70	+ 7	
	3		24.8840	13.0347	— 74	+1.4	+ 1.4	40 41 21.93	— 4 59.13	— 43	+ 40	— 9	22.68	+ 7	
	4		26.6940	14.2547	35	+ .5	+ .5	40 41 38.41	— 5 14.31	— 17	+ 14	— 9	23.68	+ 7	39.3
	5		17.5453	22.2320	— 5	—1.7	— .5	40 38 22.04	— 1 58.37	— 13	— 31	- 4	23.16	+ 6	
	6		25.3390	10.5733	—180	— .8	— .6	40 43 36.80	— 6 12.53	— 50	— 21	-14	23.42	+ 5	
	7		18.3637	24.9940	+ 66	— .5	.6	40 39 11.41	— 2 47.66	— 22	— 16	- 5	23.32	+ 6	
	8		25.1940	13.8773	— 31	— .5	— .5	40 41 10.05	— 4 45.79	— 40	— 14	—10	23.62	+ 5	38.4
	9		15.0677	25.9187	+ 32	+ 1.2	+ .5	40 31 48.49	+ 4 34.18	+ 56	+ 26	+ 10	23.59	+ 5	
	10		9.8273[ii]	30.6663[iv]	+ 2	+ .4	+ .5	40 27 35.89	+ 8 46.41	+1.19	+ 13	+ 15	23.77	+ 5	39.3
	VI 1	D	16.3347	21.9587	+ 33	— .6	—1.9	40 32 45.56	+ 3 37.94	+ 44	— 31	+ 7	23.67	—2	33.8
	2		21.3473	17.3443	36	+ .1	+ .1	40 33 25.98	+ 2 56.99	+ 36	+ 3	+ 5	23.41	—3	33.9
	3		28.5283	12.6747	+ 54	-1.7	+ .4	40 43 5.54	— 6 40.62	— 60	— 22	—12	23.98	—3	33.4
	4		23.6323	17.0387	14	— .4	— .4	40 33 36.73	+ 2 46.60	+ 31	— 12	+ 5	23.60	—3	
	5		22.4587	17.3030	— 4	+ 1.4	+ .1	40 38 33.57	— 2 10.23	— 15	+ 24	— 4	23.39	- 3	
	6		8.4177[ii]	30.0400[iv]	— 8	-1.3	2.7	40 27 16.26	- 9 6.19	+1.26	— 56	+ 20	23.35	—3	
	7		20.8230	18.7590	0	—1.0	— .9	40 37 15.77	— 52.14	— 3	— 28	— 2	23.30	—4	33.9
	8		11.8123	27.6540	— 23	—1.0	—2.3	40 43 4.62	— 6 40.13	— 60	— 48	— 12	23.29	—4	
	9		29.7663[iv]	9.4627[ii]	0	+ .3	+ 2.0	40 27 48.78	+ 8 32.90	+1.18	+ 31	+ 16	23.33	—4	
	10		23.1950	16.7707	0	+ .3	+ 1.4	40 33 40.51	+ 2 42.29	+ 33	+ 23	+ 5	23.41	—4	33.3
	11		13.1733	26.3607	— 19	+ .1	— .1	40 30 49.96	+ 5 33.09	+ 63	— 4	+ 10	23.74	—4	
Nov.	12		29.1857	7.4403	—204	— .3	+ .3	40 27 5.85	+ 9 16.38	+1.02	— 1	+ 18	23.42	—4	33.6
11	II 1	D	21.0993	19.6113	0	+1.9	1.1	40 37 0.40	— 37.59	+ 7	+ 45	— 1	23.32	+ 7	41.0
	2		19.4693	20.4147	0	— .9	0	40 36 47.10	— 23.88	+ 6	— 14	— 1	23.13	+ 7	41.2
	3		11.6753	28.2217	— 5	— .7	—1.9	40 29 24.73	+ 6 57.95	+ 76	— 21	+ 13	23.33	+ 8	40.9
	4		22.2597	17.2307	— 9	— .4	— .2	40 38 29.81	— 2 7.01	— 11	— 9	— 4	22.56	+ 7	
	5		11.1860[ii]	28.1893[iv]	+ 7	+1.8	+ .4	40 29 12.13	+ 7 9.54	+1.03	+ 34	+ 12	23.16	8	
	6		29.3940[iv]	9.9460[ii]	0	— .2	—1.1	40 28 10.78	+ 8 11.27	+1.13	— 18	+ 13	23.13	+ 8	39.9
	7		13.9190[ii]	28.9827[iv]	— 41	+ .2	+ .8	40 30 1.32	+ 6 20.41	+ 94	+ 14	+ 11	22.92	+ 8	
	8		28.0830	12.1927	+ 13	—1.4	— .7	40 43 5.86	— 6 41.43	— 61	— 32	12	23.38	+ 8	
	9		18.9023	22.0800	+ 9	+ .3	0	40 37 43.34	— 1 20.29	— 2	+ 5	— 3	23.05	+ 7	
	III 1	R	24.3340	15.2893	— 10	+ .1	+1.0	40 40 12.05	— 3 48.45	— 32	+ 14	— 7	23.35	+ 8	39.8
	2		33.0443[iv]	5.2217[ii]	— 42	+ .4	+ .4	40 24 38.62	+11 42.71	+1.50	+ 12	+ 21	23.16	+ 7	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
Nov.								° ′ ″					° ′ ″		
11	II 3	R	13.6173	25.4563	— 32	+3.0	+3.2	40 41 22.07	— 4 58.98	— 43	+ 90	— 9	40 36 23.47	+7	
	4		14.2393	26.6963	— 31	+1.4	1.9	40 41 38.57	— 5 14.76	— 47	+ 17	— 9	23.72	+7	39.2
	5		23.2953	18.6150	+ 27	— .8	0	40 38 22.21	— 1 58.29	— 13	— 13	— 4	23.62	+6	
	6		12.8933	27.6773	+ 25	+ .7	+ .4	40 42 36.96	— 6 13.51	— 50	+ 16	—14	22.97	+5	38.8
	7		23.8167	17.1840	+ 20	— .4	0	40 39 11.59	— 2 47.60	— 22	— 6	— 5	23.66	+6	38.8
	8		14.7857	26.0963	+ 30	+1.0	+1.0	40 41 10.23	— 4 45.79	— 40	+ 29	—10	24.23	+5	38.4
	9		27.0773	16.2683	+107	+ .4	+2.5	40 31 48.66	+ 4 33.31	+ 56	+ 39	+10	23.02	+5	*a*
	10		30.3027[IV]	9.4727[II]	0	—1.2	— .5	40 27 36.08	+ 8 46.18	+1.19	— 26	+15	23.34	+5	38.4
	VI 1	R	23.6223	15.0163	— 34	+ .5	+ .5	40 32 45.59	+ 3 37.32	+ 44	+ 14	+ 7	23.56	—2	35.1
	2		16.7153	23.7187	+ 9	+1.4	+1.7	40 33 26.00	+ 2 56.94	+ 36	+ 44	+ 5	23.79	—3	
	3		13.2563	29.1173	+109	—2.1	— .5	40 43 5.56	— 6 40.95	— 60	— 40	—12	23.49	—3	
	4		18.2550	24.8377	+ 60	+ .4	+1.0	40 33 36.72	+ 2 46.44	+ 34	+ 20	+ 5	23.75	—3	35.4
	5		16.9640	22.1130	— 14	0	0	40 38 33.35	— 2 10.04	— 15	0	— 4	23.12	—3	
	6		31.6458[IV]	10.0510[II]	+ 8	+ .9	+2.2	40 27 16.23	+ 9 5.53	+1.26	+ 43	+20	23.65	—3	
	7		19.2590	21.3310	+ 5	0	+1.1	40 37 15.73	— 52.35	— 3	+ 14	— 2	23.47	—4	
	8		29.6193	13.8003	+159	+ .7	— .2	40 43 4.56	— 6 40.01	— 60	+ 9	—12	23.92	—4	34.7
	9		10.8737[II]	31.2003[IV]	0	0	— .4	40 27 48.70	+ 8 33.48	+1.18	— 5	+16	23.47	—4	34.7
	10		18.1947	24.5880	+ 53	+2.4	+3.1	40 33 40.44	+ 2 41.64	+ 33	+ 79	+ 5	23.25	—4	34.3
	11		27.3423	14.2000	+ 59	+ .7	+ .7	40 30 49.80	+ 5 32.14	+ 63	+ 20	+10	22.87	—4	
	12		11.0237	33.0377	+264	— .9	— .9	40 27 5.72	+ 9 16.77	+1.02	— 26	+18	23.43	—4	34.0
Nov.															
15	II 1	R	20.2487	21.7023	+ 8	—1.0	— .3	40 37 0.39	— 36.74	+ 7	— 20	— 1	23.51	+7	
	2		21.8337	20.9147	+ 7	—2.9	—2.7	40 36 47.12	— 23.23	+ 6	— 82	— 1	23.12	+7	36.6
	3		29.4233	12.9283	+114	+ .7	0	40 29 24.80	+ 6 56.98	+ 77	+ 12	+13	22.80	+8	36.2
	4		19.5950	24.6043	+ 61	— .7	— .3	40 38 29.95	— 2 6.70	— 11	— 16	— 4	22.94	+7	
	5		29.0527[IV]	12.0497[II]	— 10	— .4	— .5	40 29 12.28	+ 7 9.50	+1.03	— 13	+12	22.80	+8	
	6		10.9813[II]	30.4260[IV]	0	+ .3	0	40 28 11.03	+ 8 11.20	+1.13	+ 5	+13	23.54	+8	35.2
	7		27.9723	12.9323	+ 40	+ .4	+ .7	40 30 1.61	+ 6 20.04	+ 69	+ 16	+11	22.61	+8	
	8		13.3687	29.2637	+123	— .8	+1.1	40 43 6.19	— 6 41.84	— 61	+ 2	—12	23.64	+8	35.5
	9	R	22.8100	19.6630	+ 23	—1.8	— .2	40 37 43.71	— 1 19.55	— 1	— 32	— 3	23.80	+7	
	III 1	D	15.9570	25.0047	+ 27	—1.7	—1.7	40 40 12.51	— 3 48.63	— 32	— 50	— 7	22.99	+8	35.1
	2		4.3587[II]	32.1950[IV]	— 80	0	—1.6	40 24 39.11	+11 42.98	+1.50	— 21	+21	23.59	+8	34.9
	3		26.0907	14.2400	+ 12	+ .2	+ .3	40 41 22.60	— 4 59.40	— 43	+ 7	— 9	22.75	+7	
	4		27.1437	14.6747	+ 66	+ .2	— .6	40 41 39.14	— 5 15.15	— 47	— 5	— 9	23.38	+7	34.4
	5		17.9140	22.6567	— 8	— .5	— .8	40 38 22.81	— 1 59.79	— 13	— 18	— 4	22.67	+6	
	6		26.5843	11.7853	— 71	+1.4	+ .2	40 42 37.56	— 6 13.67	— 50	+ 25	—14	23.50	+6	33.9
	7		17.1930	23.8570	+ 20	—1.6	— .4	40 39 12.29	— 2 48.39	— 22	— 31	— 5	23.32	+6	33.6
	8		24.7637	13.4140	— 61	— .4	— .6	40 41 10.93	— 4 46.56	— 40	— 14	—10	23.73	+5	
	9		14.3247	25.1500	— 17	—1.7	—2.8	40 31 49.35	+ 4 33.42	+ 56	— 64	+10	22.79	+5	33.6
	I 1	D	13.2557	21.8890	—124	+ .1	—2.5	40 32 45.89	+ 3 37.78	+ 44	— 31	+ 7	23.87	—1	31.1
	2		24.2337	17.2727	+ 31	+ .9	+2.2	40 33 26.27	+ 2 55.93	+ 36	+ 43	+ 5	23.04	—3	
	3		27.6823	11.8067	— 23	—1.8	— .6	40 43 5.77	— 6 40.99	— 60	— 37	—12	23.69	—3	30.7
	4		24.1097	17.5900	+ 34	+1.1	+1.5	40 33 36.85	+ 2 44.79	+ 34	+ 37	+ 5	22.40	—3	
	5		22 4503	17.2890	— 4	0	0	40 38 33.43	— 2 10.38	— 15	0	— 4	22.86	—3	30.4
	6		7.7110[II]	29.3110[IV]	— 15	+1.7	+ .6	40 27 16.25	+ 9 5.63	+1.26	+ 36	+20	23.70	—3	
	7		21.3807	19.2960	+ 6	+ .3	+ .1	40 37 15.72	— 52.68	— 3	+ 6	— 2	23.05	—4	
	8		12.8653	28.7393	+ 76	— .4	+ .7	40 43 4.50	— 6 41.20	— 60	+ 2	—12	22.60	—4	30.8
	9		29.4223[IV]	9.1107[II]	0	— .7	+ .7	40 27 48.55	+ 8 33.12	+1.18	— 2	+16	22.99	—4	30.2
	10		23.4587	17.0253	+ 10	+ .2	+ .1	40 33 40.23	+ 2 42.55	+ 33	+ 4	+ 5	23.20	—4	
	11		13.0977	26.2907	— 23	— .2	— .7	40 30 49.55	+ 5 33.23	+ 63	— 12	+10	23.39	—4	
	VI 12		29.5073	7.4477	—200	—2.2	— .9	40 27 5.38	+ 9 16.77	+1.02	— 47	+18	22.88	—4	29.9
Nov.															
16	II 1	D	20.2760	18.8000	— 3	+1.9	+1.0	40 37 0.35	— 37.28	+ 7	+ 44	— 1	23.57	+7	34.1
	2		19.1177	20.0833	— 3	—1.0	0	40 36 47.09	— 24.38	+ 6	— 16	— 1	22.60	+7	
	3		11.3123	27.8740	— 41	— .4	—2.3	40 29 24.78	+ 6 58.28	+ 77	— 36	+13	23.60	+8	33.9
	4		20.7003	15.6737	— 54	—1.2	— .4	40 38 29.95	— 2 6.84	— 11	— 24	— 4	22.72	+7	
	5		11.9890[II]	28.9993[IV]	— 9	+ .5	—1.1	40 29 12.31	+ 7 9.69	+1.03	— 6	+12	23.09	+8	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections. Micrometer	Corrections. δ	Corrections. l	Corrections. r	Latitude	Δ	Ther.
Nov.								° ′ ″					° ′ ″		
16	II 6	D	30.8710[iv]	11.4360[i]	— 3	— .1	— .4	10 28 11.01	+ 8 10.95	+ 1.13	— 6	+13	10 26 23.19	+ 8	33.5
	7		12.0360[ii]	27.1077[iv]	+ 15	—1.5	- 1.5	10 30 1.63	+ 6 20.77	+ 91	— 41	+11	23.01	+ 8	33.0
	8		27.5957	11.6507	- 33	+ 1.5	+ .9	10 43 6.23	- 6 42.71	— 61	+ 36	—12	23.15	+ 8	
	9		18.1860	21.6667	0	+ .3	— .3	10 37 43.76	- 1 20.35	- 2	+ 1	— 3	23.37	+7	
	III 1	R	24.8507	15.7863	+ 19	+ .8	— .1	10 40 12.58	— 3 49.03	- 32	+ 12	— 7	23.28	+ 8	32.6
	2		33.6286[iv]	5.8400[i]	— 13	+ .5	+ 2.3	10 24 39.19	+ 11 41.94	+ 1.50	+ 38	21	23.22	+ 8	
	3		17.3353	29.1167	+ 233	- .4	— .8	10 41 22.69	- 4 58.19	— 43	— 17	— 9	23.81	+7	
	4		14.3197	26.8030	+ 40	+ .7	+ .4	10 41 39.25	— 5 15.46	- 47	+ 16	— 9	23.39	+ 7	32.6
	5		23.5317	18.7863	+ 36	+ 2.1	+ 1.0	10 38 23.93	- 1 59.97	- 13	+ 47	— 4	23.25	+7	
	6		13.9967	28.7703	+ 120	—1.0	— .3	10 42 37.68	— 6 13.51	— 50	— 20	—14	23.33	+ 6	
	7		24.0313	17.3757	+ 29	— .9	— .9	10 39 12.42	- 2 48.20	— 22	- 26	— 5	23.69	+6	
	8		15.1290	26.1747	+ 55	- 1.5	— .5	10 41 11.07	— 4 46.76	— 40	— 30	—10	23.51	+5	32.9
	9		27.5143	16.7120	+ 134	+ .5	+ .5	10 31 49.49	+ 4 33.22	+ 56	+ 11	+ 10	23.51	+ 5	
Nov.	10		30.5040[v]	9.7220[i]	0	— .1	0	10 27 36.99	+ 8 45.00	+ 1.18	- 2	+ 15	23.30	+6	
26	II 1	R	20.1383	21.6390	+ 8	+ .6	+ .5	10 37 0.15	— 37.70	+ 7	+ 16	— 1	22.67	+ 6	29.4
	2		21.4650	20.5213	+ 5	2.1	—1.2	10 36 46.95	— 23.85	- 6	— 50	— 1	22.65	+7	
	3		30.2170	13.7320	+ 191	+ 1.2	+ 1.7	10 29 21.71	+ 6 56.91	+ 77	+ 42	+ 13	22.97	+ 8	29.5
	4		18.7467	23.7933	+ 38	+ .8	+ 1.2	10 38 30.05	— 2 7.58	— 11	+ 28	- 4	22.60	+7	
	5		29.1880[iv]	12.2317[ii]	— 12	+ 2.1	+ 1.8	10 29 12.41	+ 7 8.33	+ 91	+ 58	+ 12	22.41	+8	
	6		10.4977[ii]	29.8963[iv]	0	+ 1.9	+ 1.3	10 28 11.31	+ 8 10.06	+ 1.01	+ 48	+ 13	23.02	+ 8	
	7		27.0953[iv]	12.0680[ii]	+ 14	+ 2.0	+ .8	10 30 1.99	+ 6 19.66	+ 85	+ 42	+ 11	23.03	+ 8	29.9
	8		12.3830	28.3353	+ 33	+ 1.1	+ .4	10 43 6.70	— 6 43.08	— 61	+ 22	12	23.11	+ 8	
	9		22.6290	19.1420	+ 19	1.6	.4	10 37 41.38	1 20.56	— 2	— 30	— 3	23.47	+ 7	
	III 1		25.0043	15.9093	+ 21	+ .9	+ .6	10 40 13.50	— 3 49.83	— 33	+ 22	— 7	23.49	+ 8	29.5
	2		33.3817[iv]	5.6263[i]	— 22	— .9	+ .6	10 24 39.99	+ 11 41.19	+ 1.41	— 6	+ 21	22.74	+ 7	
	3		14.7883	26.6627	+ 51	1.6	+ .4	10 41 23.57	— 5 0.10	— 44	+ 31	— 9	23.25	+ 7	
	4		13.5203	26.0710	— 17	+ 1.3	+ 2.3	10 41 40.25	— 5 17.02	— 47	+ 51	— 9	23.18	+ 7	
	5		22.8840	18.1107	+ 14	— .9	+ .6	10 38 21.01	— 2 0.58	— 13	— 6	- 4	23.20	+ 7	
	6		13.6870	28.4903	+ 95	— .6	.2	10 42 38.78	- 6 14.21	— 50	— 12	—14	23.81	+6	28.6
	7		23.5163	16.7727	+ 5	+ .4	+ .7	10 39 13.71	— 2 50.37	- 23	+ 16	5	23.22	+7	28.4
	8		14.8497	26.2543	+ 38	- .1	+ .2	10 41 12.37	- 4 48.20	— 40	+ 1	—10	23.68	+6	28.0
	9		25.8323	15.0717	+ 30	+ 1.8	+ 2.2	10 31 50.78	+ 4 31.92	+ 56	+ 58	+ 10	23.94	+ 5	
Nov.	10		29.5170[iv]	8 8073[ii]	0	0	+1.2	10 27 38.40	+ 8 43.18	+ 1.09	+ 16	+ 15	22.98	+ 6	28.0
29	II 2	D	19.1203	20.0840	— 3	— .2	+ 1.4	10 36 46.78	— 21.31	+ 6	+ 15	— 1	22.64	+ 7	38.2
Nov. 30	3	D	11.2000	27.7497	— 51	+ 1.5	0	10 29 21.39	+ 6 57.91	+ 77	+ 21	+ 13	23.44	+ 7	45.8
	4		22.0513	17.0017	— 16	+ .5	+ .1	10 38 29.91	- 2 7.51	— 11	+ 10	— 4	22.35	+ 7	
	5		12.0107[ii]	29.0107[iv]	— 11	+ 1.7	+ 1.3	10 29 12.30	+ 7 9.39	+ 81	+ 41	+ 12	23.09	+ 8	
	6		30.2166[iv]	10.8166[ii]	0	— .2	— .2	10 28 11.24	+ 8 10.80	+ 91	— 6	+ 13	23.05	+ 8	45.3
	7		13.2217[ii]	28.2827[iv]	— 21	— .6	— .6	10 30 1.97	+ 6 20.30	+ 74	— 18	+ 11	22.94	+ 8	45.4
	8		28.4690	12.5443	+ 46	1.4	+ .2	10 43 6.74	— 6 42.37	- 61	— 20	—12	23.44	+ 8	45.2
	9		18.5067	21.7117	0	+ .9	+ 1.3	10 37 44.50	— 1 21.72	— 2	+ 32	— 3	23.05	+ 7	44.6
	III 1		16.1993	25.2800	+ 39	—1.1	—1.4	10 40 13.46	— 3 49.47	— 33	- 36	- 7	23.23	. 8	
	2		4.9677[ii]	32.7470[iv]	— 52	+ .3	+ 1.4	10 24 40.19	+ 11 41.58	+ 1.31	+ 23	+ 21	23.52	+ 7	
	3		25.8773	13.9830	— 5	0	+ 1.1	10 41 23.82	— 5 0.43	- 41	+ 14	— 9	23.00	+ 7	
	4		26.1701	13.9457	+ 17	+ .4	— .6	10 41 40.56	— 5 16.41	— 47	— 2	— 9	23.57	+ 7	
	5		18.3097	23.1320	+ 20	+ 2.2	+ 2.2	10 38 21.38	— 2 1.86	+ 13	+ 64	— 4	22.99	+ 7	13.6
	6		26.8553	12.0013	- 50	+ .8	+ .1	10 42 39.19	— 6 15.08	— 50	+ 14	—11	23.61	+ 6	
	7		17.0217	23.7637	+ 16	—1.9	—1.9	10 39 14.18	— 2 50.27	— 23	— 55	— 5	23.08	+ 7	12.3
	8		26.2690	14.8350	+ 38	+ .1	0	10 41 12.88	- 4 48.92	— 41	+ 2	—10	23.47	+ 6	
	9		11.6180	25.3867	0	— .8	—2.1	10 31 51.30	+ 4 31.26	+ 56	— 40	+ 10	22.82	+ 6	
Dec.	10		10.3670[ii]	31.0923[iv]	+ 3	—1.4	— .9	40 27 38.97	+ 8 43.52	+ 99	— 31	+ 15	23.29	+ 6	42.3
4	II 2	R	21.8137	20.9167	+ 7	— .7	— .7	40 36 46.34	— 22.68	+ 6	— 20	- 1	23.51	+ 6	28.0
	3		28.1427	11.5927	— 13	- .2	- 2.0	10 29 24.14	+ 6 58.08	+ 85	— 29	+ 13	22.91	+ 7	27.4
	4		17.9337	22.9607	+ 14	—1.5	+ .7	10 38 29.64	— 2 7.04	- 14	— 15	— 4	22.27	+7	
	5		28.7897[iv]	11.7963[ii]	— 7	+ 1.0	+ 2.0	10 29 12.02	+ 7 9.29	+ 92	+ 42	+ 12	22.77	+8	27.4

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
Dec. 4	II 6	R	10.5067[ii]	29.9317[iv]	0	+2.3	2.7	40 28 11.06	8 10.74	1.03	72	13	10 36 23.68	8	
	7		27.6140[iv]	12.5617[ii]	− 3	.6	.9	40 30 1.78	6 20.26	82	21	11	23.18	8	
	8		12.7937	28.7493	72	1.6	1.7	40 43 6.61	6 43.28	68	18	12	23.01	+7	26.8
	9		23.9800	20.7893	11	− .6	.1	40 37 44.45	1 20.72	− 3	8	3	23.59	7	
	III 1		24.0407	14.9240	29	1.4	.6	40 40 13.43	3 50.24	− 37	30	7	23.05	8	26.3
	2		32.9033[iv]	5.1437[ii]	− 46	− .8	.9	40 21 40.20	11 41.18	1.41	− 2	21	23.01	7	
	3		14.6787	26.5587	+ 46	+1.9	1.3	40 41 23.87	− 5 0.24	− 49	48	9	23.53	7	
	4		15.1763	27.7290	109	1.2	1.1	40 41 40.66	− 5 17.39	− 53	38	− 9	23.03	+7	25.8
	5		23.8393	19.0463	41	− .2	.6	40 38 21.51	− 2 1.19	− 16	5	− 4	23.20	7	25.4
	6		14.2107	29.0733	111	2.1	1.0	40 42 39.37	− 6 15.83	− 56	47	−14	23.31	6	
	7		24.5690	17.8160	47	1.1	.4	40 39 14.45	− 2 50.72	− 26	28	− 5	23.70	7	25.2
	8		15.4877	26.9547	83	1.8	1.8	40 41 13.16	− 4 49.90	− 46	52	−10	23.22	6	
	9		26.4710	15.7837	74	1.7	1.5	40 31 51.58	4 30.26	60	47	10	23.01	6	
	10		30.9723[iv]	10.2640[ii]	0	−2.3	1.6	40 27 39.28	8 43.16	1.09	− 58	15	23.10	6	24.1
	V 7	R	13.8793	28.9273	122	.5	1.5	40 42 43.71	− 6 20.49	− 63	28	− 13	22.77	0	20.2
	8		19.4373	23.8060	41	1.1	2.0	40 31 32.16	1 50.48	29	41	4	23.41	−1	
	9		14.0233	28.0180	81	1.4	− .5	40 42 17.58	− 5 53.77	60	− 29	−10	22.82	−1	
	10		23.8967	20.6393	43	.1	.6	40 37 46.05	− 1 22.41	− 9	14	− 3	23.66	−1	20.4
Dec. 5	VI 2		17.6537	24.5630	45	1.8	3.7	40 33 27.36	2 54.67	39	1.26	5	23.73	2	
	V 7	D	24.3097	9.2417	288	− .7	−1.0	40 42 43.80	− 6 19.95	− 63	− 24	−13	22.85	0	22.2
	8		21.8680	17.4967	− 10	−1.8	−1.1	40 34 32.21	1 50.41	29	− 44	4	22.51	0	
	9		27.2360	13.2353	20	− .2	−2.2	40 42 17.63	− 5 53.76	− 60	− 32	−10	22.85	− 1	22.5
	10		17.6740	20.9463	− 14	− .2	− .6	40 37 46.10	1 22.63	− 8	11	− 3	23.25	−1	
	VI 1		15.3730	23.9283	− 18	1.1	−1.6	40 32 47.10	+ 3 36.10	47	− 38	7	23.36	−1	21.4
	2		22.1087	15.1550	− 56	.5	.3	40 33 27.35	2 55.51	39	10	5	23.43	− 2	
	3		28.5230	12.6050	51	−1.2	−1.2	40 43 6.68	− 6 42.28	− 68	35	−12	23.25	−2	
	4		23.2650	16.7000	0	−1.9	−1.4	40 33 37.38	2 45.86	37	− 48	5	23.18	−2	21.4
	5		21.9187	16.8077	22	− .5	−2.1	40 38 33.80	− 2 9.82	− 17	− 36	− 4	23.41	3	
Dec. 6	6		8.5967[ii]	30.1937[iv]	− 5	+ .4	.3	40 27 16.36	− 9 5.61	1.17	10	20	23.44	−3	20.9
	II 2	D	18.2257	19.1483	− 7	0	− .4	40 36 46.22	− 23.29	− 6	− 5	− 1	22.93	6	27.0
	3		10.4123	26.9753	−129	.7	1.0	40 29 24.01	6 58.11	− 85	21	13	23.31	7	
	4		22.7350	17.7217	5	−1.1	−1.0	40 38 29.55	− 2 6.67	− 14	− 30	− 4	23.40	7	
	6		30.2470[iv]	10.7717[ii]	0	−2.3	2.9	40 28 10.95	8 12.01	1.03	− 74	13	23.38	8	25.9
	7		13.2210[ii]	28.2960[iv]	− 24	.1	1.5	40 30 1.72	− 6 20.79	82	21	11	23.65	8	
	8		27.8197	11.9000	14	− .4	.3	40 43 6.59	− 6 42.15	− 68	− 10	−12	23.51	+7	25.5
	III 1		16.1817	25.5653	55	−1.1	−1.0	40 40 13.45	− 3 49.62	37	− 30	− 7	23.09	8	
	2		4.8777[ii]	32.6633[iv]	− 57	− .8	0	40 24 40.23	11 41.81	1.44	− 13	21	23.56	7	
	3		25.6767	13.7683	− 20	1.5	2.0	40 41 23.92	− 5 0.79	49	50	− 9	23.05	7	
	4		26.0023	13.4517	− 20	+1.8	1.5	40 41 40.74	− 5 17.02	− 53	48	− 9	23.58	7	25.5
	5		17.2400	22.0143	− 13	−1.1	−1.3	40 38 24.64	− 2 1.31	− 15	− 34	− 4	22.77	7	
	6		26.1880	11.3110	−107	− .2	− .7	40 42 39.49	− 6 14.81	− 57	− 12	−14	23.85	6	
	7		17.0940	23.8753	21	.4	− .5	40 39 14.55	− 2 51.38	− 26	0	− 5	22.86	7	
	8		26.1163	14.6597	26	− .4	.4	40 41 13.30	− 4 49.50	− 46	− 2	−10	23.22	6	23.9
	9		14.1570	24.8890	− 31	−1.2	−1.5	40 31 51.73	4 31 05	61	39	10	23.10	6	
	10		10.7787[ii]	31.4697[iv]	4	− .9	− .9	40 27 39.45	8 42.74	1.09	− 26	+15	23.17	+6	23.6
Dec. 7	III 1	R	24.5037	15.4143	0	.1	− .1	40 40 13.46	− 3 49.63	− 37	0	− 7	23.39	8	30.3
	2		33.7700[iv]	6.0390[ii]	− 3	2.8	+1.2	10 24 40.26	11 40.55	1.41	60	21	23.06	+7	30.4
	3		13.4237	25.3037	− 47	−1.0	− .2	40 41 23.96	− 5 0.00	− 49	− 18	− 9	23.20	7	30.4
	4		14.0387	26.5890	25	− .7	− .2	40 41 40.79	− 5 17.12	− 53	− 14	− 9	22.91	7	
	5		23.5087	18.7177	32	− .3	0	40 38 24.70	− 2 1.11	− 15	− 5	− 4	23.35	7	
	6		14.2770	29.0987	147	− .5	− .5	40 42 39.56	− 6 14.80	− 57	− 14	−14	23.91	6	29.6
	7		23.9390	17.1823	21	−1.3	− .4	40 39 14.61	− 2 50.75	− 26	− 26	− 5	23.32	7	
	8		15.6683	27.0867	95	− .5	− .3	40 41 13.40	− 4 48.70	− 46	− 12	−10	24.02	6	
	9		27.0713	16.3660	109	− .4	− .1	40 31 51.82	4 30.72	61	− 8	10	23.17	6	
	10		31.0177[iv]	10.3567[ii]	0	− .3	1.2	40 27 39.55	8 41.95	1.08	10	15	22.83	6	

1893	Pair	P	Micrometer		Levels C	Levels A	Levels B	½ (δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
Dec.								° ′ ″					° ′ ″		
7	V 7	R	14.5463	29.5327	+ 179	-2.1	—1.6	40 42 43.94	— 6 19.06	— 63	— 55	—13	40 36 23.57	0	21.1
	8		17.7953	22.1997	0	—1.8	—2.4	40 34 32.33	+ 1 51.27	+ 29	— 60	+ 4	23.33	0	
	9		13.4833	27.4533	+ 40	—2.8	—2.6	40 42 17.77	— 5 53.04	— 60	— 79	—10	23.24	—1	
	10		22.4163	19.1627	+ 15	— .8	—1.4	40 37 46.20	— 1 22.08	— 8	— 31	— 3	23.70	—1	
	VI 1		25.3350	16.7837	+ 55	—1.8	— .6	40 32 47.19	+ 3 36.18	+ 47	— 37	+ 7	23.54	—1	22.6
	2		17.1067	24.0593	+ 23	—1.2	—1.4	40 33 27.44	+ 2 55.71	+ 39	— 38	+ 5	23.21	—2	
	3		13.1127	29.0020	+ 96	— .1	—1.6	40 43 6.74	— 6 41.67	— 68	— 22	—12	24.05	—2	21.6
	4		17.9750	24.5657	+ 52	—1.3	—1.2	40 33 37.41	+ 2 46 64	+ 37	— 36	+ 5	24.11	—2	
Dec.	5		17.3123	22.1897	— 4	0	+ .6	40 38 33.81	— 2 10.79	— 17	+ 8	— 4	22.89	—3	
10	III 1	D	16.1077	25.2177	+ 36	+ .4	+1.8	40 40 13.53	— 3 50.23	— 37	+ 30	— 7	23.16	+ 7	34.3
	2		5.0630[II]	32.8340[IV]	— 50	— .4	— .1	40 24 40.36	+11 41.42	+1.44	— 8	+21	23.35	+ 7	
	3		26.8923	15.0003	+ 67	+ .2	+ .4	40 41 24.09	— 5 0.58	— 49	+ 8	— 9	23.01	+7	34.2
	4		26.6530	14.0977	+ 28	— .6	—2.0	40 41 40.95	— 5 17.24	— 53	— 36	— 9	22.73	+7	34.1
	5		17.4637	22.2893	— 4	+ .5	— .3	40 38 24.92	— 2 1.89	— 16	+ 4	— 4	22.87	7	
	6		27.5803	12.7113	+ 12	+ .1	+ .2	40 42 39.82	— 6 15.65	— 57	+ 4	—14	23.50	+6	33.2
	7		17.7543	24.5413	+ 48	— .2	— .4	40 39 14 93	— 2 51.57	— 26	— 8	— 5	22.97	+ 7	33.1
	8		25.5970	14.1230	— 9	+ .3	— .5	40 41 13.72	— 4 49.83	— 46	— 2	10	23.31	+6	
	9		13.0147	23.7313	—103	+ .1	0	40 31 52.16	+ 4 30.53	+ 60	0	+10	23.39	6	
	10		9.8953[II]	30.5750[IV]	0	+ .2	— .3	40 27 39.90	+ 8 42.40	+ 1.08	— 1	+ 15	23.52	+ 6	32.9
	V 7	D	26.7513	11.6917	— 68	0	+ .4	40 42 44.27	— 6 20.27	— 63	+ 5	—13	23.29	0	31.4
	8		23.0380	18.6803	+ 23	—1.0	— .3	40 34 32.63	+ 1 50.14	+ 28	— 20	+ 4	22.89	0	
	9		28.3223	14.3107	+108	+ .4	+ .7	40 42 18.09	— 5 54.24	— 60	+ 16	—10	23.31	0	
	10		17.7753	21.0773	— 14	+ .5	+ .3	40 37 46.49	— 1 23.38	— 9	+ 12	— 3	23.11	—1	31.1
	VI 1		16.2233	24 7353	+ 24	+1.2	+ .8	40 32 47.45	+ 3 35.09	+ 47	+ 30	+ 7	23.38	—1	
	2		23.4947	15.5277	— 41	—2.2	—2.3	40 33 27.68	+ 2 55.90	+ 39	— 66	+ 5	23.36	—1	31.4
	3		29.0163	13.0990	+ 97	— .2	+1.3	40 43 6.96	— 6 42.35	— 68	+ 14	—12	23.95	—2	31.0
	4		22.9367	16.4053	— 15	— .5	— .9	40 33 37.58	+ 2 44.96	+ 37	— 20	+ 5	22.76	—2	
	5		21.8650	16.6947	— 22	— .5	—1.0	40 38 33.94	— 2 10.55	— 17	— 21	— 4	22.97	—2	
Dec.	6		8.4937[II]	30.0853[IV]	— 7	+ .8	+ .5	40 27 16.43	+ 9 5.44	+1.17	+ 20	+20	23.44	—2	31.5
12	III 1	R	24.3617	15.2380	— 11	+ .9	+1.9	40 40 13.50	— 3 50.45	— 37	+ 39	— 7	23.00	+7	35.6
	2		33.9073[IV]	6.1720[II]	0	— .6	— .2	40 24 40.36	+11 40.64	+1.44	— 12	+21	22.53	+ 7	
	3		12.2327	24.1467	—126	— .1	+ .4	40 41 24.11	— 5 0.65	— 49	+ 4	— 9	22.92	+7	35.1
	4		14.7793	27.3823	+ 81	+ .4	0	40 41 41.01	— 5 18.57	— 53	+ 6	— 9	21.88	+7	
	5		23.8980	19.0797	+ 42	+ .3	— .6	40 38 25.02	— 2 1.82	— 16	— 3	— 4	22.97	+ 7	
	6		13.9507	28.8090	+122	+ .5	+ .1	40 42 39.95	— 6 15.65	— 57	+ 10	—14	23.69	+6	34.7
	7		23.2857	16.4833	— 4	— .1	+ .2	40 39 15.08	— 2 51.83	— 26	+ 1	— 5	22.95	+ 7	
	8		16.3140	27.7880	+ 138	— .2	— .3	40 41 13.90	— 4 50.20	— 46	— 7	—10	23.07	+6	34.1
	9		26.7163	16.0470	+ 89	— .2	— .6	40 31 52.35	+ 4 29.75	+ 60	— 11	+10	22.69	+ 6	
Dec.	10		30.5400[IV]	9.8947[II]	0	— .2	— .6	40 27 40.09	+ 8 41.53	+1.08	— 11	+15	22.74	+6	33.9
13	1	D	15.6900	21.7970	— 14	+ .7	+ .4	40 40 13.47	— 3 50.13	— 37	+ 16	— 7	23.06	+7	18.1
	2		3.8957[II]	31.6513[IV]	—101	+1.3	+1.9	40 24 40.32	+11 40.98	+1.44	+ 46	+21	23.41	+ 7	
	3		26.2090	14.2867	+ 16	+1.3	+1.8	40 41 24.09	— 5 1.25	— 49	+ 44	— 9	22.70	+ 7	
	4		26.8303	14.2760	+ 39	+ .6	— .1	40 41 41.01	— 5 17.29	— 53	+ 8	— 9	23.18	+7	18.3
	5		17.9203	22.7453	+ 11	+ .6	+1.0	40 38 25.05	— 2 1.93	— 16	+ 22	— 4	23.14	+ 7	
	6		26.1287	11.2087	—118	+ 1.3	+1.9	40 42 39.99	— 6 16.66	— 57	+ 46	—14	23.08	+6	18.0
	7		17.8160	24.6123	+ 48	+ .3	+1.3	40 39 15.12	— 2 51.83	— 26	+ 22	— 5	23.20	+7	
	8		26.5167	15.0230	+ 52	+1.9	+2.1	40 41 13.96	— 4 50.52	— 46	+ 58	—10	23.46	+6	
	9		14.1590	21.8513	— 31	+ .8	— .2	40 31 52.42	+ 4 30.14	+ 60	+ 10	+10	23.36	+6	
	10		8.9130[II]	29.5737[IV]	0	+ .5	— .4	40 27 40.18	+ 8 41.99	+1.08	+ 3	+15	23.43	+6	17.5
	V 7	R	12.7557	27.7977	+ 23	+ 2.2	— .4	40 42 44.68	— 6 20.09	— 63	+ 30	—13	24.13	0	15.6
	8		18.1977	22.5723	+ 12	—2.1	—1.6	40 34 33.03	+ 1 50.55	+ 29	— 55	+ 4	23.36	0	
	9		13.7100	27.6977	+ 57	—1.0	— 2.4	40 42 18.51	— 5 53.54	— 60	— 96	—10	23.31	0	17.2
	10		22.5110	19.2193	+ 16	+ 1.0	+ .2	40 37 46.88	— 1 23.21	— 9	+ 14	— 3	23.69	—1	
	VI 1		25.7257	17.2580	+ 74	— .6	— .4	40 32 47.82	+ 3 34.12	+ 47	— 14	+ 7	22.34	—1	
	2		16.8790	23.8333	+ 15	— 2.0	— .9	40 33 28.05	+ 2 55.74	+ 39	— 44	+ 5	23.79	—1	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½ (δ + δ′)	Corrections Micrometer	Corrections δ	Corrections l	Corrections r	Latitude	Δ	Ther.
Dec.								° ′ ″					° ′ ″		
13	III 4	D	17.9490	24.5583	+ 49	—1.8	—1.2	40 33 37.87	+ 2 47.10	+ 37	— 44	+ 5	40 36 24.95	—2	17.0
	5		17.3163iv	22.5140iv	—310	+ .2	+ .1	40 38 34.21	— 2 10 54	— 17	+ 4	— 4	23.50	—2	
Dec.	6		32.3253iv	10.7230ii	+ 14	—1.1	— .6	40 27 16.65	+ 9 5.81	+1.17	— 26	+20	23.57	—2	16.6
17	III 1	R	24.1183	15.0183	— 23	— .3	—2.4	40 40 13.19	— 3 49.05	— 37	— 36	— 7	23.31	+7	
Dec. 20	III 1	R	23.7703	14.6727	— 42	+1.4	+ .1	40 40 13.09	— 3 49.73	— 37	+ 24	— 7	23.16	+7	28.0
	2		33.6097iv	5.8403ii	— 12	+ .7	+1.4	40 24 40.01	+ 11 41.51	+1.44	+ 30	+ 21	23.47	+ 7	
	3		14.8150	26.6960	+ 53	+1.1	+ .6	40 41 23.86	— 5 0.28	— 49	+ 26	— 9	23.26	+ 7	
	4		14.2567	26.7870	+ 38	— .3	— .6	40 41 40.86	— 5 16.65	— 53	— 13	— 9	23.46	+ 7	27.4
	5		23.5090	18.6880	+ 32	— .8	—1.2	40 38 25.02	— 2 1.88	— 16	— 28	— 4	22.66	+6	27.3
	6		14.2557	29.1213	+145	— .2	— .3	40 42 40.07	— 6 15.92	— 57	— 7	—14	23.37	+6	
	7		23.3470	16.5733	— 2	—1.0	— .5	40 39 15.24	— 2 51.11	— 26	— 22	— 5	23.60	+ 7	
	8		14.8080	26.2570	+ 35	—1.1	—1.1	40 41 14.19	— 4 49.33	— 46	— 32	—10	23.98	+ 6	27.1
	9		26.9393	16.2470	+ 100	—1.8	— .9	40 31 52.68	+ 4 30.38	+ 60	— 40	+ 10	23.36	+ 6	
	10		31.1037iv	10.4560ii	+ 3	—2.6	—1.4	40 27 40.47	+ 8 41.63	+1.08	— 60	+15	22.73	+ 6	26.4
	V 7	D	26.8353	11.7283	— 63	+2.1	+ .1	40 42 45.30	— 6 21.49	— 63	+ 36	—13	23.41	+1	26.2
	8		22.1543	17.8253	0	— .8	0	40 34 33.61	+ 1 49.36	+ 28	— 13	+ 4	23.16	0	
	9		27.3103	13.2810	+ 22	+ .2	— .9	40 42 19.15	— 5 54.48	— 60	— 8	—10	23.89	0	
	10		17.5857	20.9257	— 15	+1.4	+ .1	40 37 47.45	— 1 24.34	— 9	+ 24	— 3	23.23	0	
	VI 1		15.6803	24.1877	0	— .6	—1.1	40 32 48.36	+ 3 34.92	+ 47	— 24	+ 7	23.58	—1	26.2
	2		23.4403	16.5520	0	—1.1	—1.0	40 33 28.55	+ 2 54.02	+ 38	— 30	+ 5	22.70	—1	
	3		27.8060	11.8413	— 16	—1.0	— .4	40 43 7.76	— 6 43.27	— 68	— 21	—12	23.48	—1	26.0
	4		23.4853	16.9740	+ 9	0	+ .5	40 33 38.28	+ 2 44.52	+ 37	+ 6	+ 5	23.28	—2	25.6
	5		20.6853	15.5013	— 58	— .7	—1.8	40 38 34.57	— 2 10.82	— 17	— 35	— 4	23.19	—2	
Dec.	6		7.9370ii	29.5147iv	— 11	— .1	—1.0	40 27 16.92	+ 9 5.09	+1.17	— 14	+ 20	23.24	—2	25.6
23	III 1	D	16.3233	25.4327	+ 47	+2.5	+ 2.7	40 40 12.97	— 3 50.22	— 37	+ 75	— 7	23.06	+7	44.3
	2		5.3713ii	33.1177iv	— 37	+1.5	+ 2.2	40 24 39.97	+ 11 40.78	+1.44	+ 52	+ 21	22.92	+ 6	
	3		25.7470	13.8287	— 15	+1.8	+2.5	40 41 23.86	— 5 1.01	— 49	+ 62	— 9	22.89	+ 6	
	4		25.2740	12.6603	— 77	— .1	+ .2	40 41 40.88	— 5 18.42	— 53	+ 1	— 9	21.85	+7	43.9
	5		16.9263	21.7923	— 18	+1.4	+ 1.2	40 38 25.12	— 2 2.87	— 16	+ 38	— 4	22.43	+6	
	6		26.2500	11.2993	—106	+ 1.2	+ 2.1	40 42 40.23	— 6 17.38	— 58	+ 47	—14	22.60	+ 6	
	7		17.0940	23.9110	+ 21	+ .3	+ .5	40 39 15.40	— 2 52.25	— 26	+ 12	— 5	22.96	+7	42.6
	9		12.4247	23.0953	—143	+ .3	+ .5	40 31 52.91	+ 4 29.17	+ 60	+ 12	+10	22.90	+6	
Dec.	10		9.7820ii	30.3983iv	0	+ .9	0	40 27 40.70	+ 8 40.76	+1.08	+ 14	+ 15	22.83	+6	43.3
24	III 1	R	24.8353	15.7573	+ 18	0	— .7	40 40 12.94	— 3 49.35	— 37	— 9	— 7	23.06	+ 7	13.5
	2		33.6073iv	5.8253ii	— 12	—1.8	— .4	40 24 39.95	+11 41.74	+1.44	— 34	+21	23.00	+ 6	
	3		14.8813	26.7197	+ 57	—3.0	—4.3	40 41 23.86	— 4 59.18	— 49	—1.04	— 9	23.06	+6	
	4		14.4547	26.9967	+ 54	+ .2	— .5	40 41 40.89	— 5 16.95	— 53	— 4	— 9	23.28	+7	43.2
	5		23.7753	18.9713	+ 40	—1.2	—2.3	40 38 25.14	— 2 1.45	— 16	— 50	— 4	22.99	+ 6	
	6		14.3063	29.1707	+149	— .2	0	40 42 40.27	— 6 15.86	— 57	— 3	—14	23.67	+6	42.2
	7		24.1877	17.3863	+ 33	+ .9	+ .4	40 39 15.45	— 2 51.88	— 26	+ 20	— 5	23.46	+ 7	
	8		15.1530	26.6437	+ 62	— .6	— .2	40 41 14.46	— 4 50.41	— 46	— 12	—10	23.37	+6	
	9		26.4000	15.7607	+ 67	— .1	0	40 31 53.00	+ 4 28.91	+ 60	— 2	+ 10	22.59	+6	
	10		31.1050iv	10.4520ii	0	—1.6	—1.5	40 27 40.77	+ 8 41.70	+ 1.08	— 46	+ 15	23.24	+6	42.0
	V 7	R	12.3100	27.4207	— 12	+2.9	— .7	40 42 45.75	— 6 21.66	— 63	+ 38	—13	23.71	+1	43.4
	8		19.3173	23.5993	+ 37	+ 1.1	— .3	40 34 34.03	+ 1 48.26	+ 28	+ 14	+ 4	22.75	0	
	9		14.2723	28.3573	+110	+ .4	+ .8	40 42 19.60	— 5 56.07	— 60	+ 17	—10	23.00	0	
	10		23.2217	19.8653	+ 31	— .8	+2.7	40 37 47.87	— 1 24.86	— 9	+ 22	— 3	23.11	0	
	VI 1		25.1407	16.6877	+ 46	+ .2	+ .1	40 32 48.74	+ 3 33.64	+ 47	+ 4	+ 7	22.96	0	44.0
	2		17.3830	24.2353	+ 31	+ .5	+1.2	40 33 28.97	+ 2 53.17	+ 38	+ 24	+ 5	22.81	—1	
	3		12.0543	28.0690	+ 5	+1.0	+ 1.1	40 43 8.04	— 6 44.54	— 68	+ 30	—12	23.00	—1	
	4		17.7723	24.2717	+ 40	0	+ 1.1	40 33 38.57	+ 2 44.27	+ 37	+ 14	+ 5	23.40	—2	
	5		18.2770	23.4760	+ 27	— .3	— .3	40 38 34.82	— 2 11.39	— 18	— 9	— 4	23.12	—2	
Dec.	6		32.2200iv	10.6517ii	+ 13	+ .7	+ .4	40 27 17.12	+ 9 4.81	+1.17	+ 16	+20	23.49	—2	43.7
25	III 1	D	16.1103	25.2030	+ 35	+1.4	+1.3	40 40 12.88	— 3 49.75	— 37	+ 40	— 7	23.09	+ 6	52.4
	2		4.7813ii	32.5257iv	— 61	+ .8	+1.2	40 24 39.91	+11 40.63	+1.44	+ 28	+21	22.47	+ 6	

1893	Pair	P	Micrometer		C	Levels A	Levels B	½(δ + δ′)	Corrections: Micrometer	Corrections: δ	Corrections: l	Corrections: r	Latitude	Δ	Ther.
Dec.								° ′ ″					° ′ ″		
25	III 3	D	24.5020	12.5593	−101	+ .7	+ .7	40 41 23.82	— 5 1.40	— 49	+ 20	- 9	40 36 22.04	+6	
	4		25.4063	12.8047	— 67	+1.8	+2.0	40 41 40.87	— 5 18.13	— 53	+ 55	— 9	22.67	+7	52.0
	5		17.4017	22.2273	— 6	— .6	— .7	40 38 25.18	— 2 1.87	— 16	— 18	— 4	22.93	+6	
	6		24.8773	9.9337	−228	+1.4	+ .9	40 42 40.31	— 6 16.87	— 57	+ 34	−14	23.07	+5	51.8
	7		16.4333	23.2703	— 6	+ .2	+ .4	40 39 15.49	— 2 52.68	— 26	+ 8	— 5	22.58	+6	51.5
	8		24.9827	13.4460	— 53	+1.2	+ .7	40 41 14.53	— 4 51.27	— 46	+ 28	−10	22.98	+6	
	9		13.7100	24.3703	— 62	+1.1	+1.0	40 31 53.06	+ 4 29.11	+ 60	+ 30	+10	23.17	+5	
	10		9.4783[ii]	30.1137[iv]	0	+ .5	0	40 27 40.84	+ 8 41.22	+1.08	+ 8	+15	23.37	+6	50.8
	V 7		26.5737	11.4130	— 87	+ .9	+ .2	40 42 45.90	— 6 21.96	— 63	+ 17	−13	23.35	+1	50.2
	8		21.9587	17.6617	— 5	— .3	−1.8	40 34 34.17	+ 1 48.53	+ 28	— 28	+ 4	22.74	+1	
	9		26.9063	12.8427	— 12	— .6	+ .4	40 42 19.75	— 5 55.19	— 60	— 4	−10	23.82	0	
	10		16.4607	19.8190	— 37	+1.4	+ .4	40 37 48.01	— 1 24.74	— 9	+ 28	— 3	23.43	0	
	VI 1		15.6313	24.0823	— 8	+ .2	+ .7	40 32 48.87	+ 3 33.44	+ 47	+ 12	+ 7	22.97	0	49.2
	2		23.1593	16.3090	— 12	+1.3	+3.2	40 33 29.10	+ 2 53.00	+ 38	+ 62	+ 5	23.15	−1	
	3		27.1517	11.1357	— 79	+ .4	+1.4	40 43 8.22	— 6 44.34	— 68	+ 24	−12	23.32	−1	49.7
Dec.															
26	III 1	R	24.0003	14.9100	— 30	+2.0	+1.7	40 40 12.80	— 3 49.57	— 37	+ 54	— 7	23.33	+6	28.7
	2		33.8933[iv]	6.1453[ii]	0	+1.3	+1.7	10 24 39.81	+11 41.00	+1.44	+ 43	+ 21	22.92	+6	28.4
	3		16.9753	28.8197	+204	+1.8	+ 1.8	40 41 23.78	— 5 0.50	— 49	+ 52	−10	23.21	+6	28.2
	4		14.0523	26.5877	+ 25	+ .7	+ .8	40 41 40.84	— 5 16.74	— 53	+ 22	— 9	23.70	+7	
	5		23.5933	18.7430	+ 34	+ 1.9	+2.1	40 38 25.15	— 2 2.62	— 16	+ 58	— 4	22.91	+6	
	6		14.1067	28.9797	+ 133	+ .8	+ 1.2	40 42 40.32	— 6 16.07	— 57	+ 28	−14	23.82	+5	
	7		23.7340	16.9140	+ 14	+2.0	+1.2	40 39 15.50	— 2 52.33	— 26	+ 48	— 5	23.34	+6	27.9
	8		15.5997	27.1217	+ 92	+ 2.2	+ 2.6	40 41 14.56	— 4 51.31	— 46	+ 70	−10	23.39	+6	
	9		27.2557	16.6220	+122	+2.0	+2.9	40 31 53.11	+ 4 28.94	+ 60	+ 70	+ 10	23.45	+5	
	10		30.3373[iv]	9.7530[ii]	0	+1.9	+1.9	40 27 40.90	+ 8 40.02	+1.08	+ 55	+15	22.70	+6	27.1
	V 7	R	15.3253	30.4460	+ 258	0	— .1	10 42 46.04	— 6 22 65	— 63	— 2	−13	22.61	+1	25.9
	8		18.3097	22.6047	+ 13	−3.7	−3.5	40 34 34.32	+ 1 48.53	+ 28	−1.05	+ 4	22.12	+1	
	9		12.2753	26.4207	— 56	0	+ .8	40 42 19.91	— 5 57.22	— 61	+ 10	−10	22.08	0	
	10		21.9867	18.6630	+ 8	— .2	+ .7	40 37 48.16	— 1 23.99	— 9	+ 6	— 3	24.11	0	
	VI 1		24.2400	15.7913	0	+ .8	+ 1.8	40 32 49.01	+ 3 33.44	+ 47	+ 36	+ 7	23.35	0	
	2		17.2930	24.1723	+ 28	— .6	— .3	40 33 29.25	+ 2 53.86	+ 38	— 14	+ 5	23.40	−1	25.3
	3		13.4787	29.4697	+137	−1.3	+1.4	40 43 8.36	— 6 44.32	— 68	— 3	−12	23.21	−1	
	4		18.3983	24.8930	+ 63	+ 1.0	+ 1.3	40 33 38.81	+ 2 44.23	+ 37	+ 33	+ 5	23.79	−2	
	5		18.6083	23.8270	+ 37	+1.3	+ 1.2	40 38 35.04	— 2 11.94	— 18	+ 36	— 4	23.24	−2	
	6		32 3593[iv]	10.8103[ii]	+ 15	+1.7	+1.1	40 27 17.32	+ 9 4 43	+1.17	+ 42	+ 20	23.54	−2	25.1
Dec.															
27	V 7	D	27.1410	11.9363	— 40	+2.5	+ .5	40 42 46.18	— 6 22.73	— 63	+ 47	−13	23.16	+1	32.8
	8		21.3270	17.0340	— 24	−1.5	— .2	40 34 34.46	+ 1 48.39	+ 28	— 26	+ 4	22.91	+1	
	9		27.6547	13.5623	+ 52	+ .9	+1.0	40 42 20.06	— 5 56.13	— 61	+ 28	−10	23.50	0	
	10		18.0277	21.4313	— 7	+ 4.1	+1.5	40 37 48.30	— 1 25.97	— 9	+ 86	— 3	23.07	0	32.6
	VI 1		15.8017	24.2570	0	+ .2	— .4	40 32 49.15	+ 3 33.60	+ 47	— 2	+ 7	23.27	0	
	2		24.3893	17.5337	+ 38	— .6	— .6	40 33 29.39	+ 2 53.29	+ 38	— 18	+ 5	22.93	−1	
	3		28.2307	12.2367	+ 23	— .6	0	40 43 8.49	— 6 44.10	— 68	— 10	−12	23.49	−1	32.4
	5		22.4663	17.2300	— 5	— .9	— .5	40 38 35.16	— 2 12.26	— 18	— 21	— 4	22.47	−2	32.1
	6		8.2587[ii]	29.8127[iv]	— 9	— .5	— .9	40 27 17.42	+ 9 4.48	+1.17	— 20	+20	23.07	−2	32.4

The Constant of Aberration.

The present series appears to be much better adapted to an investigation of the aberration constant than that of 1889–90. The period covered is from October 10, 1892, to December 27, 1893—443 days. Hence if we assume, in accordance with Chandler's conclusion, that the latitude variation may be represented by two periodic terms of 12 and 14 months respectively, this series will embrace something more than the full term of 14 months. The investigation of this constant formed an important part of the original plan. To this end as many observations as possible were obtained in the morning and evening when the effect of aberration was near the maximum.

The distribution in Right Ascension of the 107 pairs of stars was as follows:

h h		*h h*		*h h*		*h h*	
0–1	4 Pairs.	6– 7	4 Pairs.	12–13	5 Pairs.	18–19	5 Pairs.
1–2	4 "	7– 8	6 "	13–14	3 "	19–20	5 "
2–3	4 "	8– 9	5 "	14–15	5 "	20–21	5 "
3–4	4 "	9–10	4 "	15–16	5 "	21–22	4 "
4–5	5 "	10–11	4 "	16–17	4 "	22–23	5 "
5–6	5 "	11–12	4 "	17–18	4 "	23–24	4 "

There were in all 1780 observations before midnight and 1120 after midnight.

We may then write for each observation an equation of the form

$$\varphi_0 + \Delta + \alpha x + \beta y + \gamma z + \delta u + \varepsilon v + \tau w = \phi,$$

where ϕ_0 is an assumed value of the latitude,

Δ a constant correction to ϕ_0,

$\alpha x + \beta y$ terms depending upon the 14 months period,

$\gamma z + \delta u$ terms depending upon the annual period,

εv correction required on account of erroneous aberration,

τw secular change in the latitude.

The longer period was assumed to be 430 days as indicated by the interval from maximum to maximum and minimum to minimum of this series in connection with that of 1889–90. The daily change of the argument is therefore 0°.837.

Let n be the number of days from January 1, 1893,

$N = 0°.837n$,

$\odot$ = the sun's true longitude,

Then

$$\alpha = \cos N, \qquad \beta = \sin N,$$
$$\gamma = \cos \odot, \qquad \delta = \sin \odot.$$

Referring to the American Ephemeris, the reduction for aberration is

$$Ce' + Dd'.$$

Let us call this quantity k, and write for C, D, c', d' their values,
Then

$$k = 20''.4451\ [-\cos\omega\cos\odot\ (\tan\omega\cos\delta - \sin\alpha\sin\delta) - \sin\odot\cos\alpha\sin\delta],$$

20″.4451 being Struve's value of the aberration constant.

Let v be the correction which this constant requires to satisfy the present series, Δk the corresponding correction to k,

Then

$$\begin{matrix} 20.4451 \\ 20.4451 + v \end{matrix} = \begin{matrix} k \\ k + \Delta k \end{matrix}, \text{ from which } \Delta k = \frac{k}{20.4451} v.$$

c of our equation therefore equals

$$\frac{k}{20.4451}.$$

It will be convenient to modify this expression as follows:

$$\Delta k = \frac{k}{20'}\ \frac{20}{20.4451} v = \frac{k}{20} v'. \quad \text{Where } v' = \frac{20}{20.4451} v,$$

v' will be the unknown quantity of our equation.

From a morning and evening observation on any pair, which observations will be separated by an interval of several months, we have a pair of equations,

$$\begin{aligned} \varphi_0 + \Delta + \alpha' x + \beta' y + \gamma' z + \delta' u + \varepsilon' v' + \tau' w &= \varphi' \\ \varphi_0 + \Delta + \alpha'' x + \beta'' y + \gamma'' z + \delta'' u + \varepsilon'' v' + \tau'' w &= \varphi'' \end{aligned}$$

By subtraction

$$(\alpha' - \alpha'') x + (\beta' - \beta'') y + (\gamma' - \gamma'') z + (\delta' - \delta'') u + (\varepsilon' - \varepsilon'') v + (\tau' - \tau'') w = \phi' - \phi''.$$

For the purpose of illustrating the method of forming these equations the data for one pair of stars will be given in full, viz.:

					h	m	s		°	′	″
B, A, C	16	Mag	4.9	α	0	4	43	δ	45	29	15
L L	220		7.5		0	11	4		35	53	25

Difference of zenith distance approximately 10′.

Date			x	y	z	u	ρ	η	*Observed* ϕ
									″
1892 December	2	1	+0.911	−0.411	−0.324	−0.946	+0.721	−0.076	3.18
	3	2	+ .918	− .397	− .307	− .952	+ .720	− .074	2.91
	5	3	+ .928	− .371	− .274	− .962	+ .717	− .068	3.00
	10	4	+ .953	− .302	− .189	− .982	+ .705	− .055	2.84
P.M.	12	5	+ .962	− .274	− .155	−0.988	+ .699	− .049	3.16
	20	6	+ .987	− .160	− .013	−1.000	+ .665	− .028	3.04
	23	7	+ .993	− .117	+ .042	−0.999	+ .650	− .019	3.13
	26	8	+ .997	− .073	+ .096	− .995	+ .632	− .011	3.12
	27	9	+ 0.998	−0.058	+0.113	−0.994	+ 0.625	−0.008	2.67
1893 July	19	10	−0.976	+ 0.218	−0.457	+0.889	−0.453	+ 0.551	3.75
	23	11	−0.987	+ .162	− .515	+ .857	− .414	+ .562	3.50
August	2	12	−1.000	+ .016	− .649	+ .760	− .310	+ .589	2.85
	5	13	−1.000	− .028	− .687	+ .727	− .277	+ .597	3.02
A.M.	6	14	−0.999	− .044	− .700	+ .714	− .266	+ .600	3.30
	7	15	− .998	− .058	− .711	+ .703	− .255	+ .603	2.89
	8	16	− .997	− .071	− .723	+ .691	− .244	+ .605	3.67
	9	17	− .996	− .087	− .735	+ .678	− .232	+ .608	3.25
	10	18	−0.995	−0.101	−0.747	+ 0.665	−0.220	+ 0.611	3.85
1893 October	31	19	−0.269	−0.963	−0.783	−0.622	+ 0.641	+0.835	3.48
November	6	20	− .182	− .983	− .712	− .705	+ .672	+ .852	3.65
	10	21	− .125	− .992	− .661	− .750	+ .689	+ .863	3.68
	11	22	− .110	− .994	− .648	− .762	+ .693	+ .865	3.72
	15	23	− .096	− .995	− .593	− .805	+ .705	+ .876	3.38
	16	24	− .038	− .999	− .579	− .815	+ .708	+ .879	3.39
P.M.	26	25	+ .108	− .994	− .427	− .904	+ .723	+ .906	3.18
	30	26	+ .167	− .986	− .362	− .932	+ .722	+ .918	3.57
December	4	27	+ .223	− .975	− .296	− .953	+ .719	+ .928	3.03
	6	28	+ .252	− .968	− .260	− .965	+ .715	+ .934	3.58
	7	29	+ .266	− .964	− .244	− .970	+ .713	+ .937	2.91
	10	30	+ .307	− .952	− .192	− .981	+ .706	+ .945	2.73
	13	31	+ .349	− .937	− .139	−0.990	+ .696	+ .953	3.18
	20	32	+ .443	− .896	− .016	−1.000	+ .667	+ .972	3.46
	24	33	+ .494	− .870	+ .054	−0.998	+ .645	+ .983	3.28
	25	34	+ .507	− .862	+ .071	− .997	+ .639	+ .986	2.67
	26	35	+ 0.520	−0.854	+0.091	−0.996	+0.633	+0.989	3.70

These are now combined by subtraction as follows:

								$\sqrt{p}$
10— 1	−1.887	+ 0.629	−0.133	+1.835	−1.174	+ 0.627	+ 0.57	0.64
11— 2	− .905	+ .559	− .208	+ .809	−1.134	+ .636	+ .59	.64
12— 3	− .928	+ .387	− .375	+ .732	−1.027	+ .657	− .15	.64
13— 4	− .953	+ .274	− .498	+ .709	−0.982	+ .652	+ .18	.64
14— 5	− .961	+ .230	− .545	+ .702	− .965	+ .649	+ .14	.64
15— 6	− .985	+ .102	− .699	+ .703	− .920	+ .631	− .15	.64
16— 7	− .990	+ .046	− .765	+ .690	− .894	+ .624	+ .54	.64
17— 8	− .993	− .014	− .831	+ .673	− .864	+ .619	+ .13	.64
18— 9	−1.993	−0.043	−0.860	+ 1.659	−0.845	+ 0.619	+1.18	0.64
19 , 20—10	+0.751	−1.191	−0.290	−1.553	+1.109	+0.293	−0.19	0.72
21 , 22—11	+ .870	−1.155	− .140	− .613	+1.105	+ .302	+ .20	.72
23 , 24—12	+0.933	−1.013	+ .063	− .570	+1.016	+ .289	+ .53	.72
25 , 26—13	+1.137	−0.962	+ .292	− .645	+0.999	+ .315	+ .36	.72
27 , 28—14	+ .236	− .927	+ .423	− .674	+ .983	+ .331	− .00	.72
29 , 30—15	+ .284	− .900	+ .493	− .679	+ .966	+ .337	− .07	.72
31 , 32—16	+ .393	− .845	+ .645	− .686	+ .925	+ .357	− .35	.72
33 , 34—17	+ .496	− .779	+ .797	− .675	+ .874	+ .376	− .27	.72
35—18	+1.515	−0.753	+ 0.838	−1.661	+0.853	+ 0.378	− .15	0.64

The following system was adopted in the assignment of weights.

Each evening or morning equation was given the weight unity where the difference of zenith distance was less than 15 revolutions of the screw (12′.6).

In case of pairs whose difference of zenith distance was 15 or more revolutions the weight $\frac{1}{2}$ was assigned.

As appears from the example, one morning observation may be combined with the mean of two or more evening observations or *vice versa*. Also the same morning or evening observation may enter into more than one combination; thus the morning series above is combined with each of the two evening series.

p_1 and p_2 being the weights of the two equations, that of the difference equation is

$$\frac{p_1\, p_2}{p_1 + p_2}$$

When the same observation equation enters into two combinations it is given in each the weight $0.7p$.

When two equations are combined into a single mean it is given weight $2p$.

When three or more equations are so combined the weight is $3p$.

In this manner were formed 1219 difference equations. When these resulted from observations made within an interval of a few days, their coefficients were so nearly equal that frequently it was advantageous to combine several difference equations into one. This was done by the simple process of addition, as shown by the following example:

	$-1.09x$	$+1.65y$	$+1.15z$	$+1.35u$	$-1.42v'$	$+0.65w$	$=+0.''27$	$\sqrt{p} = 0.64$
	-1.17	$+1.60$	$+1.10$	$+1.43$	-1.40	$+0.64$	-0.19	0.64
	-1.20	$+1.58$	$+1.06$	$+1.46$	-1.39	$+0.63$	$+0.32$	0.64
	-1.05	$+1.66$	$+1.16$	$+1.30$	-1.26	$+0.66$	$+0.15$	0.76
	-1.11	$+1.63$	$+1.12$	$+1.35$	-1.25	$+0.65$	$+0.34$	0.64
Σ	$-5.62x$	$+8.12y$	$+5.59z$	$+6.89u$	$-6.72v'$	$+3.23w$	$=+0.89$	$\sqrt{p} = 0.305$
	$-1.71x$	$+2.48y$	$+1.70z$	$+2.10u$	$-2.05v'$	$+0.99w$	$+0.27$	

The final equation is the summation equation multiplied by the square root of its weight. The latter is derived as follows:

Let $p_1 \cdot p_2 \ldots p_n$ be the weights of the individual equations, the weight of the sum is

$$\frac{(p_1 \cdot p_2 \ldots p_n)}{(\overline{p_2 \cdot p_3 \ldots p_n}) + (p_1 \cdot p_3 \ldots p_n) + \ldots + (p_1 \ldots p_{n-1} \cdot \overline{p_n})}$$

By tabulating the terms of this formula for the values of p which actually occurred the weights were readily computed.

By this process of combining, the number of equations was reduced to 190. These were then combined in the usual manner to form the six normal equations which follow:

$$\begin{aligned}
697.1376x - 82.5669y + 239.3309z - 619.6463u + 74.3262v' - 198.3408w &= -32.0961 \\
+664.8606y + 544.5932z + 408.5788u - 99.2513v' - 34.9435w &= -76.1616 \\
+639.9110z + 53.0980u - 32.9367v' - 63.8902w &= -84.4461 \\
+757.0544u - 112.3893v' + 107.7806w &= -12.3723 \\
+426.7316v' + 1.4786w &= -35.2360 \\
+126.1514w &= +13.5975
\end{aligned}$$

From which

$$\begin{aligned} x &= -.1119 \pm 1255 \\ y &= -.1090 \pm 0587 \\ z &= -.0029 \pm 0723 \\ u &= -.0572 \pm 0642 \\ v' &= -.1036 \pm 0092 \\ w &= -.0497 \pm 0919 \end{aligned}$$

The probable error of a single equation of weight unity is $\pm 0''.182$.

It was obvious from the beginning that the 12 and 14 months terms could not be separated with any certainty in a series of this character, but it was thought best to include both for the sake of completeness. The indetermination is shown very conspicuously by the large probable errors of x, y, z and u. This however does not extend to v', the probable error of which is quite small.

Remembering the significance of v' we have for the correction to Struve's value of the aberration constant

$$v' = \frac{20.4451}{20} .1059$$

Struve's value	20.4451
Resulting value of constant	**20″.551 ± 0094**

A second solution of the normal equations, excluding the terms depending on the annual period, gives

$$\begin{aligned} x &= -.0563 \pm 0097 \\ y &= -.1381 \pm 0074 \\ v' &= -.1048 \pm 0090 \\ w &= -.0177 \pm 0227 \end{aligned}$$

Correction to Struve's constant	= | .1071
Value of constant	**20″.552 ± 0092**

Finally, if we exclude from our equations every unknown quantity except v' we find

Correction	- .0844
Constant	**20″.530**

If the latitude variation can be represented by a single periodic term, and the observations were distributed uniformly throughout a full period, both with respect to the right ascensions of the stars employed and the date of observations, we should expect the last two values to be practically equal.

The value 20″.551 is that adopted in the reduction of the present series. The necessary correction to the latitude is found by multiplying the computed reduction for aberration by the factor .00518. This correction is applied to the individual values of the latitude before beginning the process of adjustment which follows.

Adjustment of the Latitude.

The corrections necessary to reduce the separate values of the latitude to the mean of the groups were derived in the usual manner and are as follows:

Group	Pairs 1	2	3	4	5	6	7	8	9	10	11	12
I	+ 6	+ 11	— 9	— 7	— 20	+ 10	+ 37	— 11	— 14	— 3		
II	— 13	+ 3	— 1	+ 40	+ 11	— 7	+ 7	— 35	— 5			
III	+ 4	+ 15	+ 21	+ 1	+ 10	— 24	— 3	— 27	+ 1	+ 2		
IV	— 21	— 9	+ 26	+ 7	+ 13	+ 3	+ 36	— 14	— 23	— 18		
V	+ 13	+ 13	— 14	— 5	— 51	+ 21	+ 16	+ 17	— 3	— 7		
VI	— 22	+ 5	— 27	+ 5	+ 12	— 2	+ 5	+ 7	+ 13	+ 3	— 10	+ 11
VII	— 6	+ 5	— 26	+ 13	— 6	+ 28	+ 24	— 6	— 26	— 0		
VIII	— 7	— 7	— 24	— 8	— 7	+ 12	+ 22	+ 18	— 7	+ 4	+ 4	
IX	+ 18	— 21	— 20	+ 11	+ 5	+ 10	— 3					
X	+ 41	— 36	— 30	+ 33	— 0	— 1	— 7	— 4	— 12	+ 16		
XI	+ 6	+ 2	— 0	— 42	— 31	+ 21	+ 12	+ 32				

Final Adjustment.

The foregoing corrections are applied where necessary to the individual latitudes, and the means for each group formed for convenient intervals, averaging for this series 23 days, we have the following values:

	I	No.	II	No.	III	No.	IV	No.	V	No.	VI	No.	VII	No.	VIII	No.	IX	No	X	No.	XI	No.
1892	//		//		//		//		//		//		//		//		//		//		//	
Oct. 10–Oct. 24	3.350	53	3.328	15					3.117	56	3.256	39										
Oct. 30–Nov. 26	3.269	27	3.066	46					3.065	4	3.240	38	3.149	25	2.390	2						
Dec. 1–Dec. 23			2.879	37	3.111	70							3.210	40	3.016	25						
Dec. 25–Jan. 20					3.162	38	3.134	49							2.970	49	2.648	14				
1893																						
Jan. 21–Feb. 16							3.040	56	3.011	67							2.892	32	3.040	21		
Feb. 20–Mar. 17									2.956	45	3.011	73					2.939	12	2.966	40		
Mar. 18–Apr. 18											3.058	58	2.991	62					2.982	34	2.966	25
Apr. 23–May 7	2.765	8											2.895	25	2.916	43					2.955	27
May 8–June 7	3.157	18													2.961	61	2.948	42			3.149	16
June 8–June 30	3.094	57	2.922	22													2.914	42	3.069	65	3.270	7
July 2–July 27	3.167	26	3.006	57	3.344	21													3.141	78	3.158	58
July 29–Aug. 10	3.100	47			3.282	67															3.186	42
Sept. 2–Sept. 23	3.223	62					3.210	67	3.128	17											3.324	50
Sept. 27–Oct. 24	3.289	99	3.179	77					3.255	70												
Oct. 25-Nov. 16			3.205	62	3.456	59					3.337	104										
Nov. 26–Dec. 6			3.119	31	3.329	40			3.066	8	3.344	7										
Dec. 7–Dec. 27					3.169	90			3.312	32	3.248	42										

In what follows, the differences of the consecutive values of the latitude are given with the weight given by the expression

$$p = \frac{nn'}{10\,(n+n')}$$

When two or more differences are combined the value of p given is the sum of the individual weights. The primed values of I–II, etc., refer to the morning series.

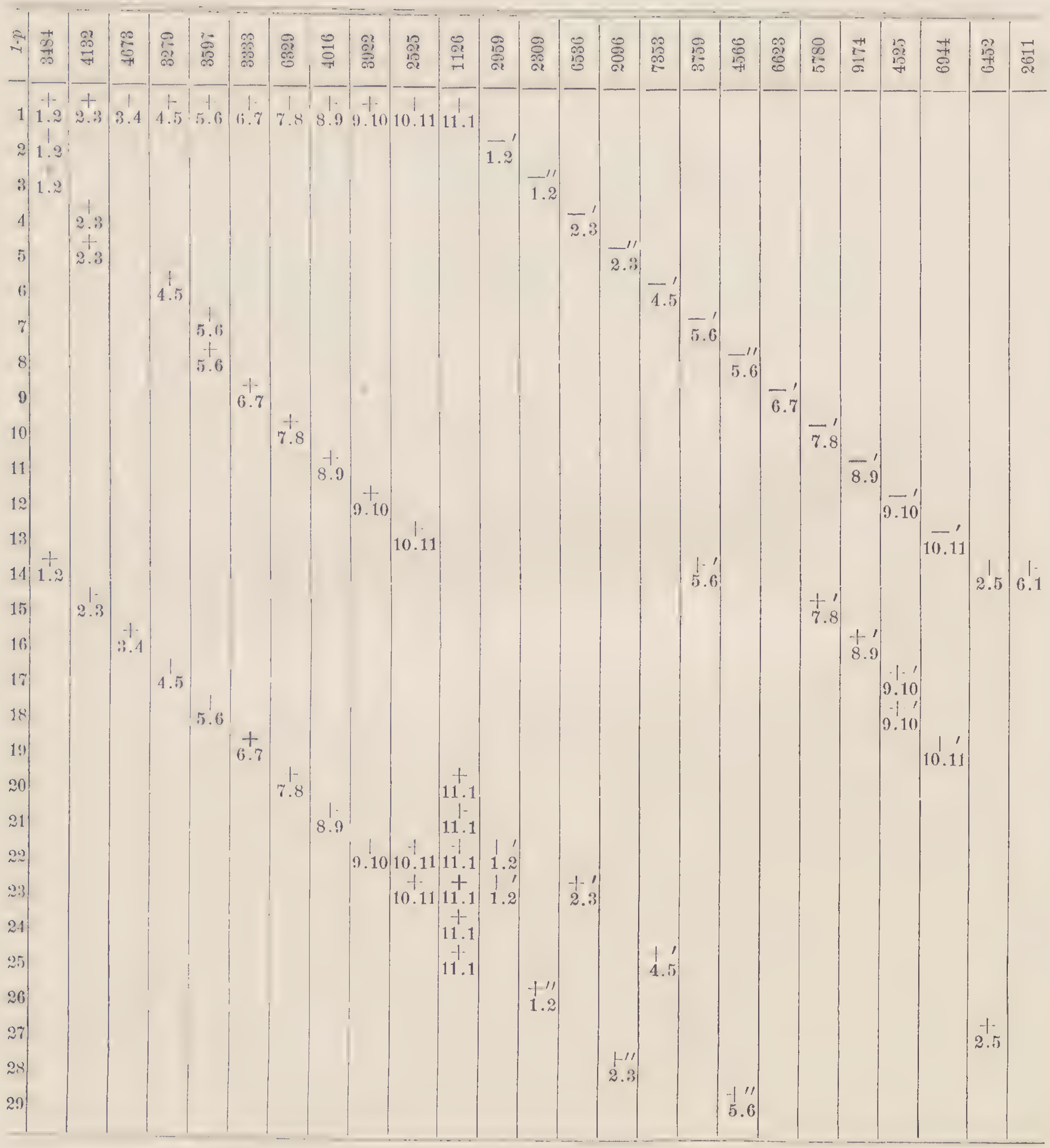
			p	$1-p$
I–	II	+ .129	2.87	.3484
II–	III	— .232	2.42	.4132
III–	IV	+ .028	2.14	.4673
IV–	V	+ .029	3.05	.3279
V–	VI	— .055	2.78	.3597
VI–	VII	+ .067	3.00	.3333
VII –	VIII	— .021	1.58	.6329
VIII–	IX	+ .013	2.49	.4016
IX–	X	— .155	2.55	.3922
X–	XI	— .046	3.96	.2525
XI–	I	+ .076	8.88	.1126

			p	$1-p$
I–	II′	+ .166	3.38	.2959
II–	III′	— .338	1.53	.6536
IV–	V′	+ .082	1.36	.7353
V–	VI′	— .144	2.66	.3759
VI–	VII′	+ .091	1.51	.6623
VII –	VIII′	+ .256	1.73	.5780
VIII–	IX′	+ .323	1.09	.9174
IX–	X′	— .098	2.21	.4525
X–	XI′	+ .016	1.44	.6944

			p	$1-p$
I–	II″	+ .110	4.33	.2309
I–	III′	— .182	2.76	.3623
I–	IV	+ .013	3.22	.3106
I–	V′	+ .024	5.45	.1835
I–	VI	+ .067	3.83	.2611
I–	VII′	— .130	0.61	1.6393
I–	VIII	+ .083	2.06	.4854
II–	III″	— .236	4.77	.2096
II–	V	+ .161	1.55	.6452
II–	V′	— .057	4.31	.2320
II–	VI	— .144	4.45	.2247
II–	VIII	— .137	1.49	.6711
II–	IX	+ .008	1.44	.6944
III–	V	— .053	3.03	.3300
III–	VI	+ .029	7.22	.1385

			p	$1-p$
III–	VII	— .099	2.55	.3922
III–	IX	+ .514	1.02	.9804
III–	X	+ .203	1.65	.6061
III–	XI	+ .130	4.12	.2127
IV–	VIII	+ .164	2.45	.4082
IV–	X	— .000	1.53	.6536
V–	VI″	+ .006	2.19	.4566
V–	IX	+ .119	2.17	.4608
V–	X	— .018	3.72	.2688
V–	XI	— .196	1.27	.7874
VI–	IX	+ .072	1.03	.9709
VI–	XI	+ .092	1.75	.5714
VII–	X	+ .009	2.20	.4545
VIII–	XI	— .104	2.93	.3413
IX–	XI	— .254	1.76	.5682

Representing by 1.2, 2.3 . . . . 1.2′, 2.3′ . . . . the required corrections to I–II, II–III, ... the conditions to be satisfied are expressed by the 29 equations following:



Employing the usual method of solution by correlates we derive the following system

3922	6711	4082	9804	4605	6536	9709	2688	4545	5714	3413	1.6393	5682	4854	6944	6061	3623	2427	3106	7874	2320	1835	1385	2247	3300	
																									−167
																									−037
																									+019
																									+106
																									+004
																									−053
																									+089
																									−061
																									−024
																									−277
																									−309
																									−057
																									−062
																									+079
+3.7	+8.2																								+062
		+4.8	+9.3																						−000
				+5.9	+10.4																				+050
						+6.9	+10.5																		−063
								+7.10	+11.6																−000
										+8.11	+1.7′														−179
												+9.11	+1.8												−082
														+2.9											+049
															+3.10										+061
																+1.3′	+3.11								+024
																		+1.4	+5.11						−025
																				+2.5′	+5.1′				+029
																				−2.5′					+218
																						+3.6	+6.2		−063
																						−3.6		+3.5	−076

of normal equations, the reciprocals of the weights being given above.

	k_1	k_2	k_3	k_4	k_5	k_6	k_7	k_8	k_9	k_{10}	k_{11}	k_{12}	k_{13}	k_{14}	k_{15}
1	4.0416	.3484	.3484	.4132	.4132	.3279	.3597	.3597	.3333	.6329	.4016	.3922	.2525	.3484	.4132
2	.3484	.6443	.3484											.3484	
3	.3484	.3484	.5793											.3484	
4	.4132			1.0668	.4132										.4132
5	.4132			.4132	.6228										.4132
6	.3279					1.0632									
7	.3597						.7356	.3597						—.3759	
8	.3597						.3597	.8163							
9	.3333								.9956						
10	.6329									1.2109					—.5780
11	.4016										1.3190				
12	.3922											.8447			
13	.2525												.9469		
14	.3484	.3484	.3484				—.3759							1.6306	
15	.4132			.4132	.4132					—.5780					2.0545
16	.4673										—.9174				
17	.3279					.3279						—.4525			
18	.3597						.3597	.3597				—.4525			
19	.3333								.3333				—.6944		
20	.7455									.6329					
21	.5142										.4016				
22	.7573	—.2959										.3922	.2525		
23	.3651	—.2959		—.6536									.2525		
24	.1126														
25	.1126					—.7353									
26			—.2309												
27														.6452	
28					—.2096										
29								—.4566							

The solution of these equations gives for k_1, k_2 — —, and finally 1.2, 2.3, . . . the

$k_1 = +.1785$	$k_{11} = -.4001$	$k_{21} = -.0049$	v, 1. 2 = .3484 ($k_1 + k_2$
$k_2 = -.1797$	$k_{12} = -.1621$	$k_{22} = -.0485$	2. 3 = .4132 ($k_1 + k_4$
$k_3 = +.1912$	$k_{13} = -.1898$	$k_{23} = +.1050$	3. 4 = 4673 ($k_1 + k_{16}$)
$k_4 = +.2553$	$k_{14} = -.0955$	$k_{24} = +.0163$	4. 5 = .3279 ($k_1 + k_6$
$k_5 = -.3257$	$k_{15} = -.0894$	$k_{25} = -.0880$	5. 6 = .3597 ($k_1 + k_7$
$k_6 = -.1661$	$k_{16} = -.1624$	$k_{26} = +.1782$	6. 7 = .3333 ($k_1 + k_9$
$k_7 = +.2128$	$k_{17} = +.0010$	$k_{27} = +.3659$	7. 8 = .6329 ($k_1 + k_{10}$
$k_8 = -.4010$	$k_{18} = -.0650$	$k_{28} = -.3081$	8. 9 = .4016 ($k_1 + k_{11}$
$k_9 = -.0557$	$k_{19} = -.0841$	$k_{29} = -.3262$	9.10 = .3922 ($k_1 + k_{12}$
$k_{10} = -.3475$	$k_{20} = -.0330$		10.11 = .2525 ($k_1 + k_{13}$
			11. 1 = .1126 ($k_1 + k_{20} + k_{21}$

k_{16}	k_{17}	k_{18}	k_{19}	k_{20}	k_{21}	k_{22}	k_{23}	k_{24}	k_{25}	k_{26}	k_{27}	k_{28}	k_{29}	
.4673	.3279	.3597	.3333	.7465	.5142	.7573	.3651	.1126	.1126					—.167
						—.2959	—.2959							—.037
										—.2309				+.019
							—.6536							+.106
												—.2096		+.004
	.3279								—.7353					—.053
		.3597												+.089
		.3597											—.4566	—.061
			.3333											—.024
				.6329										—.277
—.9174					.4016									—.309
	—.4525	—.4525				.3922								—.057
			—.6944			.2525	.2525							—.062
											.6452			+.079
														+.062
2.7733														—.000
	1.8948	.4525												+.050
	.4525	2.0519												—.063
			2.0536											—.000
				2.7261	.1126	.1126	.1126	.1126	.1126					—.179
				.1126	1.5678	.1126	.1126	.1126	.1126					—.082
				.1126	.1126	1.7476	.6610	.1126	.1126					+.049
				.1126	.1126	.6610	1.9207	.1126	.1126					+.061
				.1126	.1126	.1126	.1126	.7176	.1126					+.024
				.1126	.1126	.1126	.1126	.1126	1.9459					—.025
										.6464	—.2320			+.029
										—.2320	.8772			+.218
												.5728	—.1385	—.063
												—.1385	.9267	—.076

values following:

$+k_3+k_{14})$	$=+.033$	v, 1. $2' = .2959\ (-k_2+k_{22}+k_{23})$	$=+.070$
$+k_5+k_{15})$	$=+.008$	1. $2'' = .2309\ (-k_3+k_{26})$	$=-.003$
	$=+.008$	2. $3' = .6536\ (-k_4+k_{23})$	$=-.098$
$+k_{17})$	$=+.004$	2. $3'' = .2096\ (-k_5+k_{28})$	$=+.004$
$+k_8+k_{18})$	$=-.027$	4. $5' = .7353\ (-k_6+k_{25})$	$=+.057$
$+k_{19})$	$=+.013$	5. $6' = .3759\ (-k_7+k_{14})$	$=-.116$
$+k_{20})$	$=-.128$	5. $6'' = .4566\ (-k_8+k_{29})$	$=+.034$
$+k_{21})$	$=-.091$	6. $7' = .6623\ (-k_9)$	$=+.037$
$+k_{22})$	$=-.013$	7. $8' = .5780\ (-k_{10}+k_{15})$	$=+.149$
$+k_{22}+k_{23})$	$=+.011$	8. $9' = .9174\ (-k_{11}+k_{16})$	$=+.218$
$+k_{22}+k_{23}+k_{24}+k_{26})$	$=+.014$	9.10$' = .4525\ (-k_{12}+k_{17}+k_{18})$	$=+.044$
		10.11$' = .6944\ (-k_{13}+k_{19})$	$=+.073$

Applying these corrections to the differences of consecutive groups given on page 389 we obtain the corrected differences, viz.:

I- II	+ .096
II- III	— .240
III- IV	+ .020
IV- V	+ .025
V- VI	— .028
VI- VII	+ .054
VII-VIII	+ .107
VIII- IX	+ .104
IX- X	— .142
X- XI	— .057
XI- I	+ .062
	Σ + .001

Therefore we have

I = II	+ .096
III	— .144
IV	— .124
V	— .099
VI	— .127
VII	— .073
VIII	+ .034
IX	+ .138
X	— .004
XI	— .061

Adding .033 to each group in order to make the algebraic sum of these corrections zero, we find the following series of values which are applied to the results from the different groups to reduce all to a homogeneous system:

I	+ .033
II	+ .129
III	— .111
IV	— .091
V	— .066
VI	— .094
VII	— .040
VIII	+ .067
IX	+ .171
X	+ .029
XI	— .028

Final Values of the Latitude.

In the final results which follow, all known corrections and reductions have been applied. The tabular statements seem to require no further explanation. The folding sheet gives the individual results as derived from each observation. The probable error of a single determination, derived from these values and therefore including the outstanding error of the adjusted declinations, is as follows:

Group	I	0.″209	393	Observations.
	II	.200	343	"
	III	.206	382	"
	IV	.227	172	"
	V	.263	299	"
	VI	.239	359	"
	VII	.194	151	"
	VIII	.194	181	"
	IX	.238	139	"
	X	.207	248	"
	XI	.196	223	"
Mean,		0.″216	2890	"

Daily Mean of Latitude.

		P.M.	No.	A.M.	No.
		"		"	
1892 October	10	3.45	5	3.10	11
	11	3.38	12	3.03	9
	14	3.28	12	3.18	13
	16			3.17	18
	19	3.37	12	2.93	19
	21	3.53	12	3.20	19
	23	3.46	10	2.96	6
	24	3 29	5		
	30	3.13	14	2.94	16
November	5	3.23	8		
	8	3.22	12		
	11	3.55	12		
	13	3.27	15	3.27	12
	16			3.08	13
	17	3.02	12		
	20			3.60	4
	22			2.97	11
	26			3.13	13
December	1	2.99	13		
	2	3.19	14		
	3	2.91	15		
	5	2.93	16	3.36	13
	9			3.50	8
	10	3.04	15		
	11			3.15	13
	12	3.13	14		
	15			3.19	3
	17			2.96	16
	18			2.94	11
	20	2.81	12		
	22			2.88	2
	23	3.04	8		
	25			3.17	8
	26	2.85	17		
	27	3.14	14	3.07	12
	28	2.93	18	2.92	9
1893 January	3			2.95	10
	7			3.03	5
	13	3.21	13		
	16	3.09	12		
	17	3.16	13		
	19			3.01	11
	20			2.77	8
	21	2.78	20		
	23	3.14	9		
	25	2.93	20		
	26	3.09	19		
February	3			2.92	10
	4	2.71	18	3.21	10
	8	3.17	15		
	11			3.12	12
	14	2.98	14		
	15	2.85	8	3.13	11
	16			2.92	10
	20	2.76	22		
	24	2.78	5		
	25			2.90	12
	26	2.94	21	3.08	11
March	1	2.82	15	2.87	10
			521		379

		P.M.	No.	A.M.	No.
		"		"	
1893 March	6	2.92	17		
	7	2.90	17	2.87	4
	13	3.10	14	3.39	6
	16	3.02	7		
	17			3.11	10
	18	2.83	21	3.15	9
	21	3.10	5		
	27	2.98	20	2.88	7
	28	2.80	20	2.88	5
	29	3.11	21	3.04	7
April	2	2.92	17		
	4	3.07	6	2.62	9
	16	3.12	11		
	17			3.10	11
	18			3.09	10
	23			3.07	6
	24	2.86	19		
	25	3.03	2	2.66	9
	28	2.88	17		
May	6	2.96	15	2.84	10
	7	3.07	15	3.06	10
	8	2.88	15		
	9	2.95	16		
	10	3.14	18		
	11			3.16	11
	12	3.01	15		
	19	3.14	16	2.98	11
	31	3.24	12		
June	7	3.16	11	3.32	12
	8	3.06	17	3.11	11
	9	3.05	17	3.17	13
	11	3.01	13	3.10	2
	13	3.08	17		
	14			3.03	10
	17			3.19	14
	20	3.16	14		
	23	3.17	15	3.02	8
	24	3.13	14		
	28			3.25	14
	30			2.99	14
July	2	3.15	18	3.62	1
	5			3.24	12
	7	3.05	9		
	9	3.26	18	3.12	14
	10	3.20	18	3.18	12
	11	2.98	12		
	16	3.24	9		
	17	3.26	10	3.15	13
	18	3.09	9	3.06	11
	19	3.05	10	3.19	14
	20	3.23	15	3.44	1
	23			3.17	16
	27	3.08	18		
	29	3.11	18		
	30	3.22	17		
August	2			3.23	8
	5	3.06	16	3.26	9
	6			3.21	10
	7	3.07	2	3.18	10
			653		364

		P.M.	No.	A.M.	No.
		"		"	
1893 August	8	3.23	18	3.11	10
	9	3.09	18	3.18	10
	10			3.05	10
September	2	3.32	18	3.04	9
	3	3.33	16	3.27	5
	6	3.27	18		
	8	3.21	17	3.09	10
	9	3.23	17		
	12	3.22	14		
	16	3 33	12		
	17			3.12	7
	19			2.97	7
	20			3.22	17
	21			3.06	12
	23			3.08	17
	27	3.31	16		
	28	3.34	14		
	29	3.15	18	3.29	10
	30	3.46	18	3.33	10
October	1	3.21	18	3.31	10
	2			3.33	10
	3	3.34	11		
	7			2.96	10
	8			3.08	10
	9			3.00	10
	14	3.30	17		
	17	3.47	18		
	18	3.23	17		
	20	3.44	6		
	21	3.35	5		
	24	3.28	18		
	25			2.91	12
	28			3.49	10
	29			3,10	12
	30			3.50	12
	31	3.35	18	3.19	11
November	3	3.23	9		
	6	3.38	19	3.33	11
	10	3 36	19	3.37	12
	11	3.36	19	3.36	12
	15	3.27	18	3.02	12
	16	3.37	19		
	26	3.20	19		
	29	2.87	1		
	30	3.24	17		
December	4	3.24	18	3.25	5
	5			3.05	10
	6	3.27	16		
	7	3.27	10	3.42	9
	10	3.14	10	3.15	10
	12	2.80	10		
	13	3.16	10	3.56	9
	17	3.34	1		
	20	3.26	10	3.22	10
	23	2.70	9		
	24	3.12	10	3.04	10
	25	2.79	10	3.15	7
	26	3.23	10	3.05	10
	27			3.00	9
			606		377

Weighted Mean Date			ϕ P.M.	No.	ϕ A.M.	No.	Mean	A.M.–P.M.
			″		″		″	″
1892	October	17	3.397	18	3.095	95	3.246	— .302
	November	12	3.234	73	3.106	69	3.170	— .128
	December	10	3.004	107	3.147	66	3.076	+ .143
1893	January	5	3.048	87	2.991	63	3.020	— .057
	February	3	2.944	123	3.065	53	3.004	+ .121
	March	3	2.900	118	3.025	53	2.962	+ .125
	March	31	2.958	121	2.977	58	2.968	+ .019
	May	1	2.938	68	2.895	35	2.916	— .043
	May	18	3.066	103	3.155	34	3.110	+ .089
	June	17	3.093	107	3.115	86	3.104	+ .022
	July	13	3.162	128	3.170	94	3.166	+ .008
	August	4	3.131	107	3.172	67	3.152	+ .041
	September	11	3.271	112	3.107	84	3.189	— .164
	October	7	3.315	176	3.185	70	3.250	— .130
	November	6	3.343	121	3.247	104	3.295	— .096
	December	2	3.232	71	3.117	15	3.174	— .115
	December	18	3.059	90	3.194	74	3.126	+ .135
				1780		1120		

I

Date	1	2	3	4	5	6	7	8	9	10
1892 Oct. 10				3.44		3.63		3.25		3.00
Oct. 11	3.53	3.85	3.03	3.35	3.62	2.94	3.24	3.03	3.50	
Oct. 14		2.62	3.07	2.90	3.27	3.15	3.61	3.59	3.54	3.82
Oct. 19	3.08	3.30	3.52	3.44	3.51	3.39	4.33	2.36	3.86	2.75
Oct. 21	3.36	3.22	4.01	3.26	3.37	3.69		3.59	3.80	3.44
Oct. 23	3.30	3.59	3.33	3.78	3.76			3.37	3.28	
Oct. 24		3.12	3.48	3.53	3.10	3.27				
Oct. 30					2.87	3.20	3.14	2.85	3.23	2.44
Nov. 5					2.80	3.17	3.23	3.67	3.60	
Nov. 8								3.48	3.41	2.90
Nov. 11						4.02	3.52		3.19	4.60
Nov. 13					3.65	3.30	3.10	3.12	3.23	3.21
Nov. 17								3.70	3.02	3.42
1893 Apr. 25	2.29	2.98								
May 6	2.87	2.88	3.22							
May 7	2.72	3.12	2.28							
May 11	2.92	2.94	3.39	3.21						
May 19	2.08	2.49		3.24	3.48	3.66				
June 7		3.18	3.43	3.12	3.38	2.98	3.32	3.45	3.17	3.92
June 8	2.63		3.24	3.82	3.16	2.95	2.87	2.91	2.95	3.25
June 9	3.61	2.75	3.09	3.14	2.89	3.36	2.91	2.88	3.04	3.39
June 14	2.95	2.84	3.16	2.80	3.35	3.21	3.06	2.67	3.17	3.10
June 17	3.11	3.28	3.41	3.31	2.72	2.89	3.58	3.07	3.31	2.63
June 23				3.25	3.20	3.61		2.59	2.79	2.75
June 28					3.24	3.31	3.78	3.37	3.31	3.75
June 30					3.15	3.07	2.84	2.81	2.64	3.16
July 2	3.62									
July 5						3.29	2.95	3.66	3.50	3.28
July 9	2.67					3.61	2.96	3.05	3.22	2.93
July 10	3.12									
July 17	2.82									
July 19	3.15									
July 20	3.44									
July 27	2.81	3.30	3.21	3.20	3.13	2.60	3.16	3.50	3.48	3.46
July 29	3.45	2.79	3.25	3.11	3.48	3.49	2.67	3.12	3.03	2.93
July 30	3.10		3.31	2.93	2.93	3.30	2.95	3.36	2.84	3.95
Aug. 5	2.70	3.47	2.80		2.62	3.01	3.60	2.84	2.76	
Aug. 8	3.23	3.19	3.32	3.29	3.08	3.44	3.22	3.72	2.67	3.26
Aug. 9	3.03	3.24	3.32	3.34	3.20	3.20	2.55	3.17	2.99	2.85
Sept. 2	3.30	3.20	3.15	3.03	3.23	3.40	3.40	3.39	3.29	3.46
Sept. 3	3.46	3.43	2.86	3.56	3.53	3.38	3.20	3.44	3.25	3.57
Sept. 6	3.37	3.30	2.84	2.88	3.26	3.17	2.96	3.33	3.49	3.65
Sept. 8	3.22	3.31	3.25	3.62	3.08	3.46	3.50	3.85	3.05	2.57
Sept. 9	3.04	3.43	3.61	2.67	2.62	2.99	3.17	3.19	3.03	
Sept. 12	2.95	2.97	3.03	3.53	3.55	3.35	3.54	2.99		
Sept. 16	3.17	3.09	3.36	3.42	3.27					
Sept. 27		3.68	3.03	3.70	3.13	3.46	2.94	3.61	3.41	2.61
Sept. 28	3.89		3.39	3.07	3.12	3.31	3.25	3.58		3.31
Sept. 29		3.80	2.99	3.39	3.18	3.05	3.05	2.82	3.15	2.42
Sept. 30		3.31	3.61	3.16	2.76	3.47	3.65	3.67	3.51	3.85
Oct. 1		3.26	2.71	3.57	3.13	3.79	3.33	2.99	3.12	3.29
Oct. 3		3.83	3.70	3.03	2.87	3.43	3.20	3.39	3.21	3.52
Oct. 14		3.37	3.09	3.16	3.42	3.47	2.93	3.55	3.06	2.93
Oct. 17		3.73	3.47	3.04	3.33	3.59	3.82	3.79	3.60	3.41
Oct. 18		3.62		3.50	3.38	3.21	2.93	3.05	3.13	2.74
Oct. 20		3.80	3.55	3.41	2.93	3.33	3.65			
Oct. 21		3.65	3.23	3.25	3.39	3.24				
Oct. 24		3.71	3.48	3.28	3.24	3.36	3.09	3.20	3.08	3.39

II

Date	1	2	3	4	5	6	7	8	9
1892 Oct. 10	3.91								
Oct. 11	3.53	3.09	3.83						
Oct. 14	2.99	3.32	3.46						
Oct. 19	3.95	2.97							
Oct. 21	3.46	3.45	3.68						
Oct. 23	3.55	2.94	3.74						
Oct. 30	2.73	3.48	4.02	2.83		2.90	3.62	3.17	3.29
Nov. 5		3.30	3.30		2.76				
Nov. 8	2.77	3.30	3.43	2.62	3.47	3.26	2.97	3.60	3.37
Nov. 11	3.13	3.44	3.17	3.34		3.48	3.41	3.38	3.95
Nov. 13	3.57	3.20	3.37	3.30	3.70	3.13	3.20	3.20	2.76
Nov. 17	2.69	3.19	2.91	3.34	2.76	3.11	2.71	2.48	2.91
Dec. 1			3.15	3.14	2.91	2.52	3.08	3.00	2.70
Dec. 2			3.49	2.97	3.06	3.44	3.00	3.11	3.37
Dec. 3			3.17			2.61	3.06	3.12	2.64
Dec. 5			2.06		2.58	2.99	2.91	3.15	3.27
Dec. 10				3.24	3.05	2.77	2.93	2.97	
Dec. 12					2.66	2.98	2.72	3.12	3.37
Dec. 20								3.84	3.20
1893 June 17	2.87	3.54	2.96	2.96					
June 23	3.00	3.00							
June 28	3.13	3.33	2.94	3.07	3.35	2.90	2.72	3.24	
June 30	2.91	2.93	2.79	3.10	3.40	2.58	3.41	3.01	
July 5	3.41	2.97	2.88	3.03		3.06	3.30	3.57	
July 9	3.21	3.17	3.24	3.15	2.75	3.11		3.51	
July 10	3.09	3.27	2.87	3.63	3.08	3.25	3.26	3.02	3.11
July 17	3.01	2.78	3.58	3.50	3.41	2.87	3.14	3.34	2.77
July 18			2.83	2.83	2.85	3.01	2.60	2.81	3.61
July 19	2.94	3.82	2.70	3.11	3.20	3.08	3.19	3.40	2.63
July 23	3.41	3.99	3.00	3.28	2.78	2.75	2.71	3.57	3.32
Sept. 27		3.05		3.60	3.22	3.37	3.66	3.53	2.98
Sept. 28	3.25	3.60		3.14	2.81	3.61	3.11		
Sept. 29	2.86	3.05	3.28	3.05	3.69	3.13	3.38	3.26	3.18
Sept. 30	3.37	3.38	2.96	3.43	3.80	3.57	3.42	3.64	3.77
Oct. 1	3.42	3.00	3.19	2.96	3.55	3.04	3.41	3.25	2.82
Oct. 3	3.22	3.34							
Oct. 14	3.34	3.52	3.67		3.83	3.04	3.28	3.31	3.05
Oct. 17	3.31	3.75	3.48	3.82	3.20	3.36	3.26	3.29	3.25
Oct. 18	3.58	2.69	3.54	3.35	3.41	3.23	3.24	3.41	2.97
Oct. 24	2.89	3.51	2.72	3.54	3.31	3.52	3.41	2.93	3.43
Oct. 31	3.71	3.10	3.83	3.33	3.49	3.28	3.61	3.20	2.73
Nov. 3		3.68	2.82	3.60	3.17	3.23	2.67	3.16	3.13
Nov. 6	3.84	2.97	3.47	2.96	3.14	3.36	3.59	3.38	3.44
Nov. 10	3.46	3.13	2.82	3.47	3.36	3.71	3.50	3.34	3.51
Nov. 11	3.39	3.36	3.53	3.16	3.48	3.27	3.20	3.24	3.20
Nov. 15	3.58	3.35	3.00	3.54	3.12	3.68	2.89	3.50	3.95
Nov. 16	3.64	2.83	3.80	3.30	3.41	3.33	3.29	3.01	3.52
Nov. 26	2.73	2.88	3.17	3.20	2.73	3.16	3.31	2.97	3.62
Nov. 29		2.87							
Nov. 30			3.63	2.95	3.41	3.19	3.22	3.30	3.20
Dec. 4		3.73	3.10	2.87	3.09	3.82	3.46	2.86	3.71
Dec. 6		3.15	3.53	3.00		3.52	3.93	3.39	

III

Date	1	2	3	4	5	6	7	8	9	10
1892 Dec. 1	2.71	3.05	2.89			3.00	3.47	3.30		
Dec. 2	3.50	3.47			3.15	3.18	3.08	2.84	2.99	
Dec. 3	2.40	2.85	2.91	2.88	2.99	3.17	2.71	3.05	3.41	2.69
Dec. 5	2.89	2.48	2.95	2.97	3.23	2.80	3.63	2.53	2.71	3.66
Dec. 10	3.16	3.10	2.98	2.81	2.95	3.06	2.86	3.09	3.38	3.25
Dec. 12	3.64	2.94	3.38	3.13		3.57	3.40	3.04	3.05	2.89
Dec. 20	2.67	2.31	2.71	3.01	2.46	1.68	2.83	2.75	3.21	3.01
Dec. 23	3.07	2.72	3.20	3.10	2.96	3.21	2.97	3.05		
Dec. 26		3.73	2.95	3.09	2.76	3.03	2.46	3.39	2.95	3.11
Dec. 27	3.18	3.08	3.42	2.63	3.67	3.07	3.02	3.19		2.68
Dec. 28	2.89	3.02	2.97		2.95	2.62	2.82	2.93	3.18	2.81
1893 Jan. 13						3.02	2.80	3.70		2.85
Jan. 16							3.19		3.16	3.35
Jan. 17							3.05	3.29	3.38	2.60
July 9	3.14									
July 10	3.39	3.11								
July 17	3.38	3.20	3.15							
July 18	3.50	3.42	3.29		2.94					
July 19	3.28	3.42		3.60	3.17					
July 23	3.36	2.97	2.52	3.36	3.38	3.32	3.01			
Aug. 2	3.27	3.54		2.72	2.88	3.55	3.13	2.99		3.76
Aug. 5	3.26	3.19	3.19	2.89		3.17	3.23	3.37	3.53	3.54
Aug. 6	3.23	3.57	2.65	3.17	3.13	3.21	3.06	3.32	3.27	3.51
Aug. 7	3.17	2.82	3.50	2.76	3.78	3.01	3.07	3.32	3.03	3.32
Aug. 8	2.98	3.85	2.87	3.55	3.10	2.86	2.92	2.71	2.92	3.30
Aug. 9	3.09	2.83	3.27	3.13	3.62	3.45	3.09	3.44	2.92	3.01
Aug. 10	3.22	3.00	2.36	3.73	2.87	3.07	2.74	3.35	3.06	3.11
Oct. 31	3.43	3.48		3.45	2.94	3.34	2.89	3.66	3.46	3.38
Nov. 3	3.56									
Nov. 6	3.66	3.41	3.34	3.62	3.50	4.08	3.88	3.13	2.97	2.54
Nov. 10	3.08	3.81	2.85	3.65	3.21	3.12	3.24	3.29	3.54	3.73
Nov. 11	3.36	3.27	3.64	3.69	3.67	2.67	3.58	3.90	2.97	3.30
Nov. 15	3.00	3.71	2.92	3.35	2.72	3.21	3.24	3.40	2.74	
Nov. 16	3.29	3.34	3.98	3.36	3.31	3.04	3.61	3.18	3.46	3.27
Nov. 26	3.50	2.85	3.42	3.15	3.26	3.52	3.15	3.36	3.89	2.95
Nov. 30	3.24	3.63	3.17	3.54	3.05	3.32	3.01	3.15	2.78	3.26
Dec. 4	3.06	3.12	3.70	3.00	3.26	3.02	3.63	2.90	2.97	3.07
Dec. 6	3.10	3.67	3.22	3.55	2.83	3.56	2.79	2.90	3.06	3.14
Dec. 7	3.40	3.17	3.37	2.88	3.41	3.62	3.25	3.70	3.13	2.80
Dec. 10	3.16	3.46	3.18	2.70	2.93	3.21	2.90	2.99	3.35	3.49
Dec. 12	3.00	2.64	3.09	1.85	3.03	3.40	2.88	2.75	2.65	2.71
Dec. 13	3.06	3.52	2.87	3.15	3.20	2.79	3.13	3.14	3.32	3.40
Dec. 17	3.34									
Dec. 20	3.16	3.58	3.43	3.43	2.71	3.08	3.53	3.66	3.32	2.70
Dec. 23	3.06	3.02	3.05	1.82	2.48	2.31	2.89		2.86	2.80
Dec. 24	3.06	3.10	3.22	3.25	3.04	3.38	3.39	3.05	2.55	3.21
Dec. 25	3.08	2.57	2.20	2.64	2.98	2.77	2.50	2.66	3.12	3.34
Dec. 26	3.32	3.02	3.37	3.67	2.96	3.52	3.26	3.07	3.40	2.67

IV

Date	1	2	3	4	5	6	7	8	9	10
1892 Dec. 26	2.65	2.79	2.57	3.23	3.01			2.14	2.70	1.96
Dec. 27	2.85	3.34	3.25	3.36	3.20					
Dec. 28	2.87	2.41	3.28	3.32	3.18	3.15	2.44	2.83	3.08	
1893 Jan. 13	3.28	2.82	2.57	3.82	3.49	2.80		3.73	3.11	3.76
Jan. 16	3.21	2.87	3.11	3.44	2.57		3.36	2.96	2.99	2.83
Jan. 17	2.89	3.42	3.03	2.89	3.09	3.95		3.04	3.39	3.15
Jan. 21	3.07	2.44	3.19	2.88	2.70	2.34	2.93	2.52	2.06	2.95
Jan. 23	3.16	3.25	2.69	3.42	3.39		3.03	2.87	2.92	3.56
Jan. 25	2.80	2.63	2.82	2.45	2.65	2.91	2.96	2.82	2.79	2.80
Jan. 26	3.13	3.46	3.14	2.95	3.06	2.77	3.00	3.39		3.12
Feb. 4			3.26	3.13	2.52	2.55	2.41	2.41	2.52	3.16
Feb. 8					3.99	3.25	3.18	3.09	3.55	3.59
Feb. 14							3.55	2.99	2.74	2.30
Sept. 2		3.31	2.78	2.65	2.98	2.76	3.12	2.84	3.81	3.09
Sept. 3	3.32	2.90		3.50	3.35	3.27				
Sept. 8	2.78	3.05	3.59	2.77	2.89	2.80	3.68	3.27	3.39	2.71
Sept. 17		3.61	2.76	3.17	3.12	2.92	2.84	3.45		
Sept. 19	2.96	2.83	3.40	3.22	2.90		3.25	2.22		
Sept. 20	3.06	3.16	3.56	2.87	2.76	4.12	3.07	3.49	3.53	3.44
Sept. 21	3.21	2.76	2.71	3.45	3.11	3.03		3.25	2.87	3.04
Sept. 23	2.87	3.42	2.87	2.76	3.66	3.16	3.10	3.34	2.93	2.82

V

Date	1	2	3	4	5	6	7	8	9	10
1892 Oct. 10				3.66	3.83	2.86	2.92	2.99	2.76	2.76
Oct. 11					2.47	3.33	2.60	3.10	2.84	3.40
Oct. 14	2.90		2.83	3.64		2.71	2.97	3.77	3.51	
Oct. 16	3.06	3.02	3.40	3.28	2.42	3.46	3.37	3.59	3.26	3.26
Oct. 19	3.25	3.01	2.60	2.79	2.67	2.36	3.38	2.83	2.69	1.90
Oct. 21	3.00	3.23	3.33	2.88	3.18	3.59	2.74	2.77	2.97	3.68
Oct. 23	3.24	3.09	2.83	3.43	3.02	2.16				
Oct. 30						2.29	2.38		4.01	3.30
1893 Jan. 21	2.87	2.73	2.78	2.76	3.04	2.17	3.11	3.11	3.18	2.80
Jan. 25	3.29	3.13	3.42	2.76	2.97	2.78	2.77	2.88	3.07	3.86
Jan. 26	3.19	3.13	2.95	2.98	3.31	3.38	2.95	3.12	2.70	3.04
Feb. 4	3.16	3.03	2.53	2.61	2.67	2.96	2.78	2.99	2.07	2.09
Feb. 8	2.75	2.72		3.38	3.34	2.47	2.81	3.71	2.81	2.89
Feb. 14	2.69	2.94	2.76	3.74	2.86	2.86	3.13	3.01	2.91	3.21
Feb. 15	2.63	2.58		3.36	2.60	3.18	2.79	3.11	2.54	
Feb. 20	3.24	2.63	2.65	2.85	2.69	2.00	2.42	2.56	2.73	2.42
Feb. 24	2.57	2.56	2.73	2.96	3.06					
Feb. 26	2.51		2.76	3.05	3.11	3.63	2.46	3.01	2.72	3.14
Mar. 1		2.74	2.17	3.12	2.96	2.24	3.17	3.14	3.23	2.78
Mar. 6						2.75	2.66	3.48	2.80	3.16
Mar. 7						2.74	3.04	3.09	3.10	2.90
Mar. 13								3.43		3.81
Sept. 20	2.37	3.25	2.79	3.29	2.75	3.55	3.31			
Sept. 21	2.97	2.97	3.23							
Sept. 23	2.47	2.96		3.42	3.48	2.88	3.22	3.07		
Sept. 27	2.86	3.23	3.28	2.70	3.78	3.71	3.06	3.20	3.15	3.89
Sept. 28	3.34	3.38	3.04	4.24	3.47	2.27	3.51	2.97	4.08	2.96
Sept. 29	3.33	3.46	3.14	3.30	2.39	3.90	3.03	3.27	3.40	3.91
Sept. 30	2.63	3.52	2.96	3.62	3.62	3.08	2.93	3.27	4.59	3.06
Oct. 2	3.33	2.65	3.80	2.53	2.99	3.25	3.12	2.70	2.38	2.80
Oct. 3	2.91	3.03	3.24	2.83	3.70	2.48	3.44	3.49	3.10	2.61
Oct. 7	2.97	2.96	3.02	2.69	2.78	3.73	3.51	2.85	2.55	2.96
Dec. 4							2.86	3.50	2.71	3.51
Dec. 5							2.94	2.61	2.74	3.10
Dec. 7							3.66	3.43	3.13	3.55
Dec. 10							3.38	2.99	3.21	2.96
Dec. 13							4.22	3.46	3.21	3.54
Dec. 20							3.51	3.26	3.79	3.09
Dec. 24							3.81	2.85	2.90	2.97
Dec. 25							3.45	2.85	3.72	3.29
Dec. 26							2.71	2.23	1.98	3.97
Dec. 27							3.26	3.02	3.40	2.93

VI

Date	1	2	3	4	5	6	7	8	9	10	11	12
1892 Oct. 10	2.73		3.42	3.22		2.97						
Oct. 11	3.11		2.82	3.60								
Oct. 14	2.86	3.59	3.26	3.06		2.72	3.52					
Oct. 16	2.55	3.78	2.94	3.16	2.77	3.19	3.70	2.88				
Oct. 19	3.01	3.59	2.95	2.86	3.57	2.55	3.78	2.82	3.11			
Oct. 21	2.49	3.97	2.98	3.51	3.10	2.72	3.45	3.64	3.53			
Oct. 30	3.35	3.28	3.04	2.46	2.74	3.43		2.35	3.14	2.28	2.99	3.02
Nov. 13			2.64	2.87	2.91	2.86		3.91	3.50	3.36	3.36	4.34
Nov. 16				2.73	2.97		2.88	2.88	3.02	3.47	2.65	3.15
Nov. 20							3.70	3.87	3.02	3.81		
Nov. 22									3.34	3.18	2.88	3.78
Nov. 26										3.23	3.30	
Dec. 5												3.76
1893 Feb. 20	2.86	2.85	2.65	3.25	2.56	2.48	3.32	3.05	2.67	3.33	3.80	2.30
Feb. 26	3.08	2.81	2.86	2.73	3.13	2.78	3.24	3.20	3.29	3.18	2.28	2.77
Mar. 1	2.95	2.97	2.71	2.78	2.59	2.68						
Mar. 6	2.47	2.96	2.58	3.36	2.81	2.81	2.96	3.16	2.71	3.20	2.69	3.09
Mar. 7	2.64	2.73	2.60	2.40	3.02	2.78	2.65	3.14	2.89	3.35	3.37	2.92
Mar. 13	2.81	3.48	2.96	3.38	3.43	3.19	2.71	2.98	3.26	2.34	2.27	3.38
Mar. 16	3.13	2.90	2.77	3.42		3.12			3.14	2.64		
Mar. 18	2.77	2.91	2.84	2.92	2.81	2.53	3.08	3.28	2.99	3.06	2.61	2.92
Mar. 21	3.21	3.22	2.79	3.02	3.25							
Mar. 27		3.40		3.17	3.07	2.93	3.19	2.76	2.57	3.16	2.09	2.58
Mar. 28		2.99	2.64	2.87	2.94	2.82	2.85	2.90	2.62		2.46	2.92
Mar. 29		3.49	3.09	3.05	3.29	3.78	2.89	2.66	3.18	3.32	3.08	2.77
Apr. 2						2.86	3.21	3.31	2.41	3.08	2.39	2.90
Apr. 4										3.33	3.55	2.65
Oct. 25	3.09	2.81	3.62	2.74	2.74	3.11	2.90	2.60	3.07	2.78	2.70	2.76
Oct. 28	3.55	3.53	3.19	3.95	2.88	3.93	3.06	3.27	3.44	4.12		
Oct. 29	3.01	2.75	3.49	2.61	3.45	3.21	3.29	2.68	3.04	3.14	3.60	2.98
Oct. 30	3.67	3.12	3.08	3.90	3.25	3.68	2.66	4.11	3.42	3.47	3.54	4.11
Oct. 31	3.29	2.89		3.57	3.37	2.72	3.09	3.03	3.07	2.97	3.82	3.23
Nov. 10	2.97	2.81	3.46	3.47	3.56	3.17	3.23	3.58	3.31	3.65		3.44
Nov. 11	3.34	3.34	3.59	3.53	3.39	3.21	3.22	3.23	3.33	3.34	3.51	3.40
Nov. 15	3.23	3.72	3.10	3.68	3.12	3.51	3.39	3.86	3.47	3.15	2.64	3.41
Nov. 16	3.55	2.97	3.30	2.33	2.86	3.56	2.97	2.54	2.99	3.10	3.16	2.86
Dec. 4		3.67										
Dec. 5	3.04	3.37	2.87	3.12	3.41	3.30						
Dec. 7	3.22	3.15	3.67	4.05	2.89							
Dec. 10	3.06	3.31	3.57	2.70	2.98	3.31						
Dec. 13	2.62	3.74		4.89	3.51	3.44						
Dec. 20	3.26	2.65	3.11	3.22	3.20	3.11						
Dec. 24	2.65	2.76	2.63	3.34	3.13	3.36						
Dec. 25	2.66	3.10	2.95									
Dec. 26	3.04	3.35	2.84	3.73	3.25	3.41						
Dec. 27	2.96	2.88	3.12		2.48	2.94						

VII

Date	1	2	3	4	5	6	7	8	9	10
1892 Oct. 30		2.94								
Nov. 13	3.50	3.43	2.85							
Nov. 16	3.26	2.81	3.13		3.59		3.49			
Nov. 22		2.53	2.96		2.69	3.80	3.16	1.98		2.40
Nov. 26	3.25	3.21	3.41		3.44	3.19	3.03	3.34	3.13	3.21
Dec. 5	3.53	2.85	3.06	3.20	2.76	3.22	3.36	3.33	3.83	3.69
Dec. 9	3.20	3.78	3.60		3.37	3.36	3.56	3.37		3.73
Dec. 11				3.13	3.03	3.32	3.21	2.17	3.26	3.23
Dec. 15				2.84	3.39		3.35			
Dec. 17				3.20	3.04	3.11	3.42	3.00	3.06	2.35
Dec. 18								2.59	2.83	2.72
Dec. 22									3.10	2.67
1893 Mar. 18	2.97	2.97	2.61		2.63	2.68	2.82	2.75	2.26	2.96
Mar. 27	2.99	3.07	3.05	3.14	3.03	3.10	2.70	2.77	2.83	3.02
Mar. 28	2.71	2.61	2.66	3.27	2.68	3.32	2.95	3.01	2.27	2.47
Mar. 29	3.15	3.39	3.13	2.84	3.25	3.00	3.13	3.01	3.05	2.69
Apr. 2	2.93	2.56	2.68	3.23	3.04	3.00	2.71	2.96	3.11	3.18
Apr. 4			3.44	2.84	2.80					
Apr. 16	3.14	3.38	3.23	3.18	3.29	2.64	3.41	3.06	3.35	2.85
Apr. 24			2.95	3.02	2.64	3.15	3.19	2.46	2.56	2.85
Apr. 25						2.82	3.24			
Apr. 28				2.85	2.86	2.80	2.82	2.75	2.76	2.80
May 6							2.95	2.91	2.44	2.45
May 7							3.07	2.71	2.82	3.50

VIII

Date	1	2	3	4	5	6	7	8	9	10	11
1892 Nov. 26	2.66	2.26									
Dec. 5	3.45	3.67									
Dec. 11	3.10	3.43	2.84	3.52	3.43	3.33					
Dec. 17	2.53	2.94	2.63	2.47	2.99	3.35	2.63	3.51	3.08		
Dec. 18	3.71	2.71	3.03	3.12	2.69	3.05	3.06	2.87			
Dec. 25	3.05	3.24		3.17	2.63		3.16		3.71	3.42	2.96
Dec. 27	3.49	3.12	3.08	3.00	3.08	2.33	3.31	2.85	2.99	3.32	3.16
Dec. 28			2.53	3.20	3.40	2.74	2.87		3.23	2.54	2.80
1893 Jan. 3			3.14	2.53	3.17	3.03	3.02	2.71	2.98	3.26	3.38
Jan. 7				3.05		3.12	2.83	3.40			2.73
Jan. 19						2.88	3.07	2.90		2.69	3.38
Jan. 20									3.12	3.07	3.13
Apr. 16		2.75									
Apr. 24	2.91	2.92	2.81	3.04	2.88	3.09	2.99	2.58	2.58	2.61	3.06
Apr. 28	2.51	2.69		2.89	3.52	3.56	2.74	2.71	2.96	3.18	2.58
May 6	3.20	3.08	3.70	3.10	2.82	2.95	3.25	2.60	2.87	2.82	3.20
May 7	2.76	2.91	2.82	2.64	3.19	3.95	2.90	3.28	3.13	3.40	3.01
May 8	2.77	2.83	2.81	3.13	3.19	2.58	3.03	3.21	2.72	2.73	2.91
May 9		2.75	3.17	2.79	3.13	3.12	2.61	2.89	2.73	2.87	3.12
May 10	3.25	3.31	3.04	3.30	3.04	2.77	3.04	3.39	3.38	2.97	2.70
May 12	3.00	2.77	2.50	2.83	3.10	3.13	2.65	3.24	2.85	2.79	2.81
May 19		2.98	3.01		3.74	3.09	3.20	3.38	2.24	3.08	3.46
May 31						3.55	3.31		2.83	3.46	3.04
June 7								3.32	3.31	3.63	3.31

IX

Date	1	2	3	4	5	6	7
1892 Dec. 27	3.14						
Dec. 28	2.99						
1893 Jan. 3	2.28						
Jan. 19	3.69	2.98	2.83	2.95	2.75	3.02	
Jan. 20	2.34	2.48	2.90		2.62	2.48	
Feb. 3	2.98	3.15	2.77	3.58	3.04	3.20	1.78
Feb. 4	3.83	3.11	3.22	2.89	3.36	3.17	2.76
Feb. 11	2.99	3.33	2.85	3.19	3.47	2.83	3.29
Feb. 15	3.02	3.08	3.63	3.15	2.63		
Feb. 16		3.36	3.07	2.31	2.65	2.91	3.37
Feb. 25				3.41	2.92	2.69	3.47
Feb. 26				2.96	1.95	3.51	3.39
Mar. 1						2.71	3.35
Mar. 7							3.20
Mar. 13							3.75
May 8	3.15	3.21	2.65		2.29		
May 9		3.02	3.10	2.97	2.71	3.15	3.04
May 10	3.30	3.26	3.52	3.26	2.81	3.35	2.74
May 12	3.05	3.21	3.47	3.79			
May 19	2.76	2.93	2.94	3.01	3.61	3.22	3.57
May 31	2.92	3.23	3.29	3.12	3.35	2.88	3.87
June 7	2.60	2.90	3.04	3.08	3.14	3.17	3.24
June 8	3.32	2.93	3.12	2.82	2.89	2.77	3.36
June 9	3.20	2.97	2.80	2.91	2.62	3.05	2.95
June 11	2.86	3.16	2.93	2.83	3.23	2.79	3.14
June 13	3.16	3.01	2.97	3.28	3.19	3.61	3.07
June 20			2.94		3.28	3.00	3.77
June 23			3.12	3.26	3.20	3.11	3.35
June 24			3.12	3.69	2.95	2.34	3.46

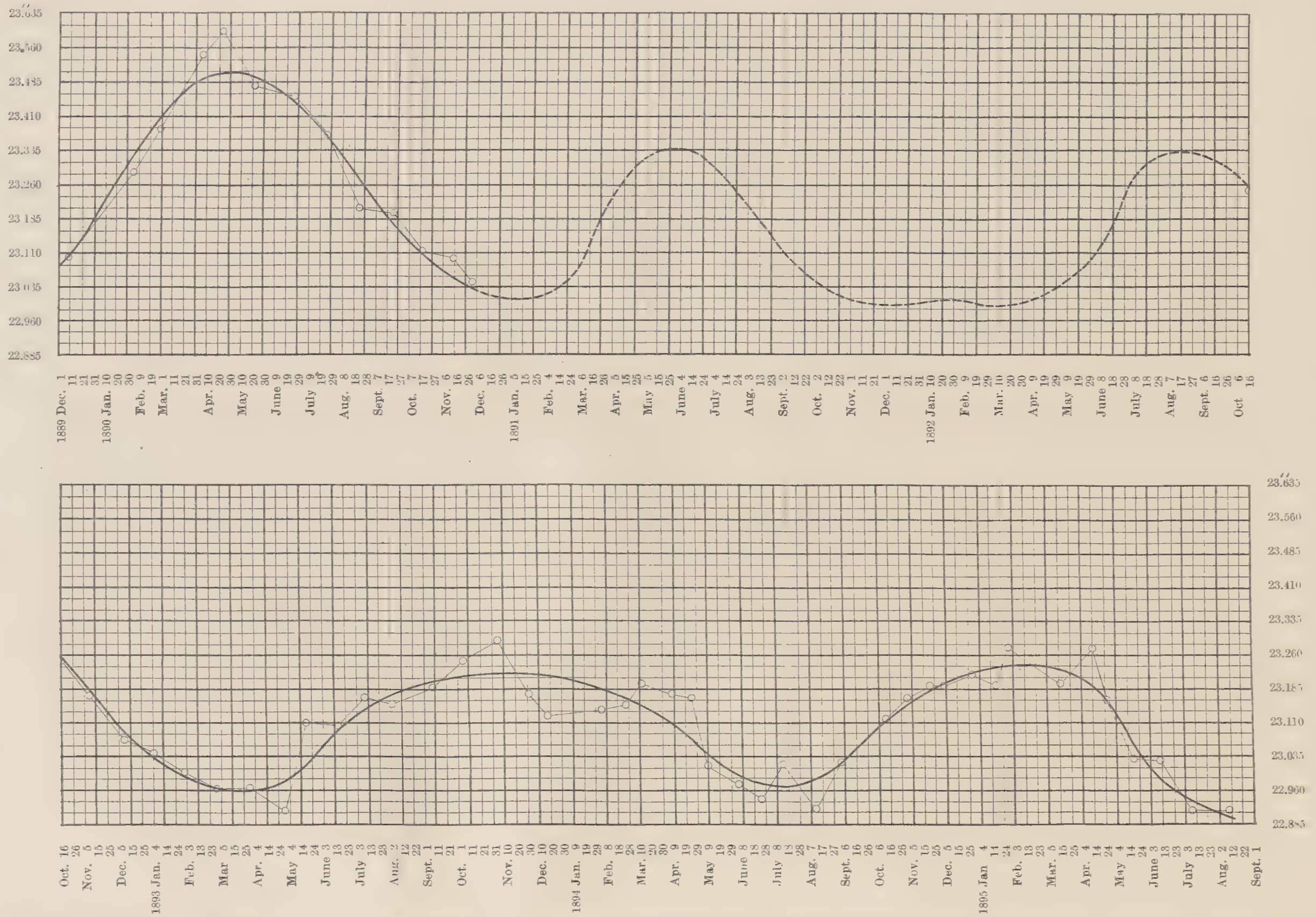
X

Date	1	2	3	4	5	6	7	8	9	10
1893 Feb. 3	2.92	2.94	2.89							
Feb. 4	3.30		3.04	3.44						
Feb. 11	3.22	3.00	2.89	3.63	2.76					
Feb. 15	2.83	2.98	3.72	3.32	3.19	2.83				
Feb. 16	2.64		3.61	3.16		2.17				
Feb. 25	2.84	2.66	3.23	2.91	3.07	2.42	2.50	2.68		
Feb. 26	3.79	2.61	2.85		3.50	3.05	3.27	3.03		
Mar. 1	2.35	2.42	2.86	3.22	3.45	2.31	2.80	3.19		
Mar. 7	3.25	2.62	2.41							
Mar. 13	3.23	3.85	2.81	2.98	3.70					
Mar. 17		2.87	2.64	3.06	2.99	3.64	3.19	3.41	2.73	3.45
Mar. 18		3.11	3.16	3.32	3.38	2.98	2.93		3.10	3.00
Mar. 27						3.04	2.87	2.80	2.54	3.69
Mar. 28						2.89	3.05	2.68	3.19	2.58
Mar. 29						3.17	2.18		3.18	3.43
Apr. 4							2.54	2.77	3.35	3.04
Apr. 17							2.89	3.11	2.86	3.46
Apr. 18							2.44	3.33	3.10	3.24
June 8	2.91	3.08	2.84	2.88	3.32	2.74	3.55	2.99	3.38	3.13
June 9	3.25	3.40	3.22	3.04	3.20	3.58	2.41	3.32	3.59	2.27
June 11	2.74	3.30	2.89	3.22	2.87	3.11				
June 13	2.65	3.33	3.06	3.25	2.65	3.11	2.76	3.18	3.10	3.02
June 20	3.15	3.01	3.34	2.43	3.56	3.04	3.28	3.24	2.86	3.33
June 23	3.11	3.25	3.05	2.85	3.18	3.07	3.17	3.34	3.26	3.27
June 24	3.11		3.51	3.42	3.05	3.30	3.10	3.11	2.81	2.88
July 2	2.69	2.72	3.13	3.32	3.18	3.13	3.14	2.71	3.02	2.97
July 7	3.06	2.93	3.33	3.65	2.21	2.85	3.38	3.21	2.86	
July 9	3.33	3.40	3.14	3.46	3.73	3.45	3.38	3.46	3.70	3.07
July 10	3.28	3.25	3.66	2.95	3.50	2.84	3.51	2.90	2.87	2.91
July 11	3.14	2.67	3.30	3.22	2.88	2.90	2.89	3.12	2.98	2.82
July 16	3.22	3.13	2.99	3.19	3.69	3.83	3.28	3.22	3.73	
July 17									3.02	4.22
July 18	3.60	3.05	3.34	3.64	2.76	2.72	2.99	2.99	2.69	
July 19									3.24	3.51
July 20			3.47	3.48	3.10	3.12	3.18		3.12	3.22

XI

Date	1	2	3	4	5	6	7	8
1893 Mar. 17	3.15							
Mar. 18	3.35							
Mar. 27	2.68	2.51						
Mar. 29	3.45	3.08	2.77					
Apr. 4	2.66	2.53	2.04	2.55	2.07			
Apr. 17	3.35	3.21	3.01	3.10	3.09	2.98	3.04	
Apr. 18	2.99	3.60	2.72	2.73	2.82	3.89		
Apr. 23		3.47	3.05	3.15	2.96	2.99	2.78	
Apr. 25		2.48	2.28	2.99	2.39	2.66	3.02	2.87
May 6		3.18	2.75	2.92	3.08	2.36	2.79	2.34
May 7		3.17	3.38	4.04	2.86	3.18	2.69	3.14
May 11		4.12	2.94	3.09	2.72	3.63	3.13	2.66
May 19		3.55		2.69	2.44	3.16	3.45	2.50
June 7						3.36	2.98	3.49
June 8						3.23	3.16	
June 9						3.11	3.45	3.54
June 11						3.25	2.94	
July 2	3.32	3.23	3.62	3.56	3.37	3.19	3.16	3.19
July 9	3.29	2.68	3.89	3.35	3.12	3.19	2.98	2.56
July 10	3.09	3.64	3.45	3.44	3.41	2.96	2.76	3.23
July 11	2.95	2.90						
July 17	3.13	2.90	2.96	3.16	3.38	3.64	3.22	2.99
July 19	2.58	3.05	3.20	2.69	3.19	3.02	3.03	3.00
July 20	3.14	3.15	3.41	3.42	3.12	3.24	2.93	3.35
July 27	2.89	2.91	3.22	2.85	2.98	2.94	2.86	2.86
July 29	2.67	2.97	2.92	3.25	3.32	3.30	3.24	2.92
July 30	3.30	3.22	3.53	3.54	3.04	3.24	3.16	2.98
Aug. 5	3.08	3.09	2.97	3.17	3.21	3.27	3.02	3.43
Aug. 7	2.99	3.15						
Aug. 8	3.54	3.24	2.83	3.06	3.33	3.03	3.51	3.24
Aug. 9	3.04	2.95	2.98	3.24	3.18	2.93	3.06	3.42
Sept. 2	3.24	3.77	3.55	2.88	3.34	3.29	3.49	3.30
Sept. 3	3.04	2.95			2.89	3.95	3.42	3.34
Sept. 6	3.40	4.16	3.27	2.75	2.94	3.14	3.56	3.37
Sept. 8	3.31	2.74	2.68	3.04		3.35	3.23	3.34
Sept. 9	3.69	3.48	3.29	3.17	3.43	3.21	3.37	3.55
Sept. 12		3.18	2.91		3.14	2.94	3.43	3.56
Sept. 16		3.94	3.08	3.06	3.17	3.21	3.45	3.71

Diagram Showing the Variations of Latitude at the Sayre Observatory, South Bethlehem, from December 11, 1889, to August 12, 1895.



That part of the curve shown by the dotted line is taken from Th. Albrecht's paper entitled "Bericht über den Stand der Erforschung der Breitenvariation im December, 1897." Berlin, 1898.

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